ELECTRICAL REVIEW

FRIDAY
SEPTEMBER 1959

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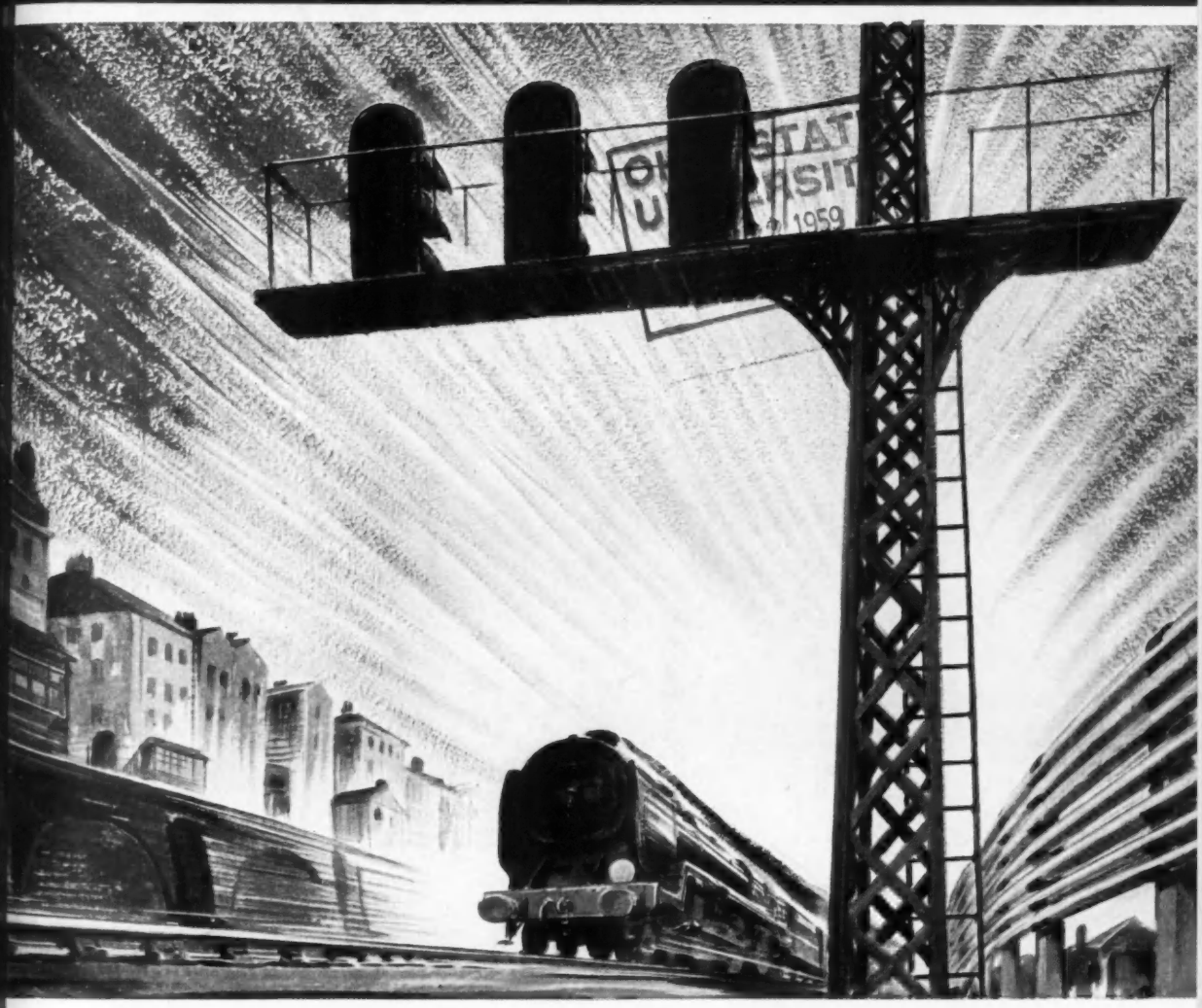

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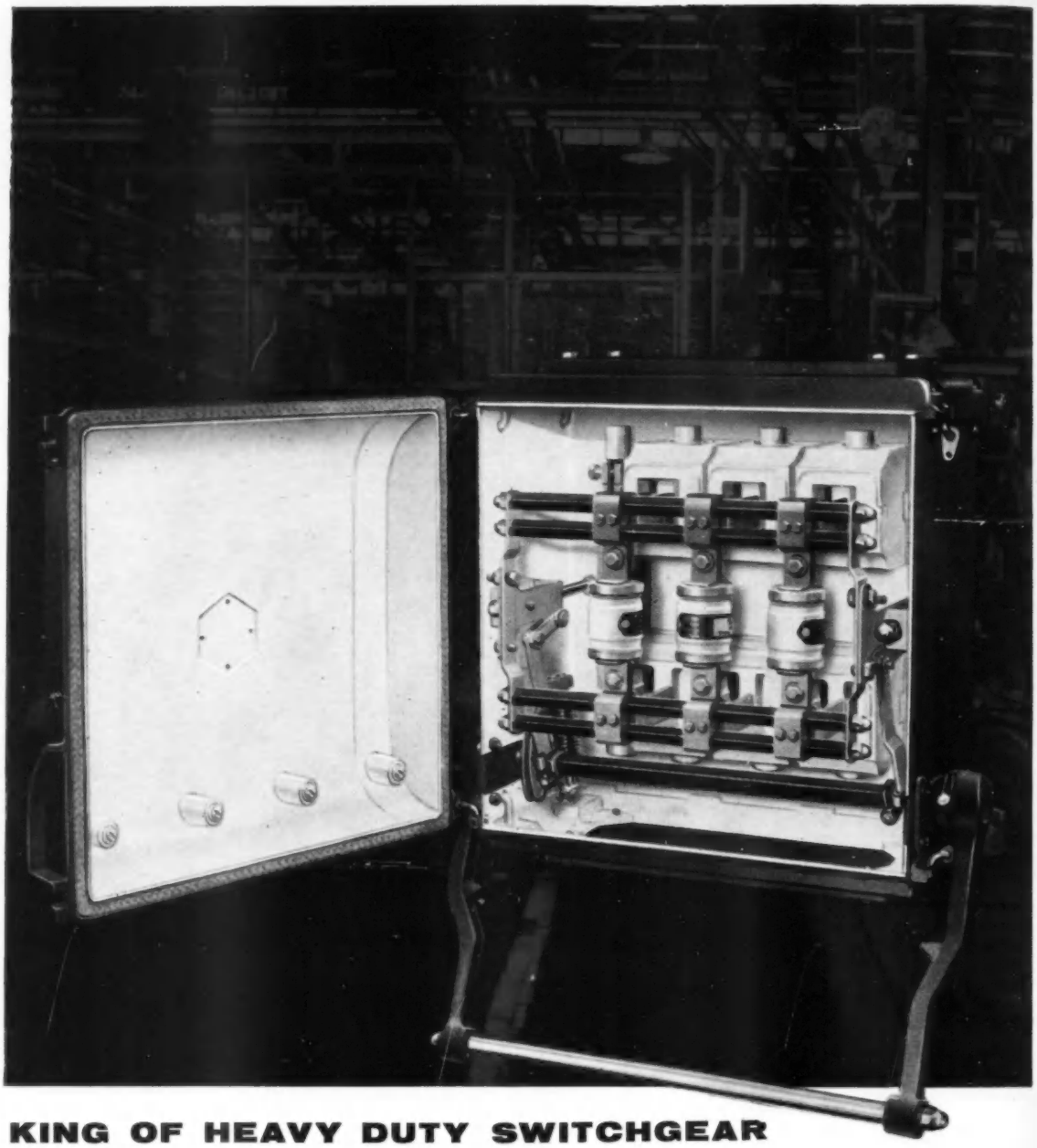

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ELECTRICAL REVIEW

4 September 1959 Vol. 165 No. 4 Established 1872

Oil Fired Power Stations

ALTHOUGH the quantity of small coal at present available exceeds that needed to build up reserve stocks at power stations, any risk of shortage during the next few years cannot be countenanced. Apart from the likelihood of an even more rapid growth of electrical output at higher load factors, the competitive market for small bituminous coal in other industries will no doubt be appreciably broadened as a consequence of researches now in hand. Possibly not before 1965, when nuclear stations are expected to produce about one third of the kWh output for public supplies, will the position be fully assured. To guard against any interim gap the flexible plan devised by the Central Electricity Authority to use oil for firing thirteen existing coal-fired stations has attractions, such as greater ease of control, less cumbrous handling plant and smaller, neater, storage space.

Although it entails no fundamental departure from established combustion principles, the application of such principles to specific projects raises numerous problems. Leaving out of account possible variations in the relative prices of coal and oil, matters for consideration include the cost of modifying existing boilers and questions of comparative maintenance charges. An outstanding factor is the high proportion of sulphur usual in Middle East residual oils, the effect of which is to cause corrosion of the cooler metal surfaces of boiler plant, more especially of air preheaters. A second, though less serious, problem is created by the presence of more than a small trace of sodium, which results in rapid fouling of superheater passages. This effect is likely to be more pronounced as steam temperatures advance beyond present limits owing to vanadium contaminant, which has also handicapped the development of larger gas turbines for efficient continuous running.

The full-scale investigations carried out at the earliest stations to be converted, which were described by Messrs. K. E. Dadswell and F. R. Thompson and by Dr. H. E. Crossley at the recent oil-firing conference arranged by the Institute of Fuel (*Electrical Review*, 22nd May), added considerably to the store of practical knowledge of the subject. The authors showed that corrosion can be significantly lessened by reducing the

amount of excess air for combustion. This course, however, implies a raising of flue-gas exit temperatures with consequently lower overall thermal efficiency. Probably a longer period of operation under commercial conditions will be necessary before firm conclusions can be reached. Results of the introduction of "additives," such as dolomite, to the flue gases have proved disappointing at home and abroad, but the position would be changed if, as Dr. Crossley pointed out, further research could be made to reveal a means of considerably reducing at source (hitherto not regarded as feasible) the proportion of sulphur in residual fuel oils.

INVENTION AND DEVELOPMENT

The Bacon fuel cell, which was described in our last issue as a result of a general Press visit, received headlines and leads in many national daily and evening papers. The B.B.C. and I.T.V. gave it pride of place in their news bulletins and topical programmes. Many members of the general public seem to feel, however, that it is probably another flash-in-the-pan, similar to the acclamations that accompanied the release of information about ZETA. It was not, of course, the National Research Development Council's intention that the device should be hailed as an immediately revolutionary invention. The object of the Press visit was to gain publicity so that British industry would take up the idea and develop it into practical commercial forms. American industry is already spending large sums on its development, under licence from this country.

At present, the fuel cell is an uneconomic form of electricity generation but this point has, we feel, been greatly overstressed. Provided the device shows promise, as has now been proved, a pre-judgment of its economics before any commercial development has taken place would be most unfair.

POWER AND AMENITIES

So long as the demand for electricity continues to rise means for satisfying the demand must be provided in the shape of power stations and transmission lines. As practically every project of this kind must now interfere with the scenery of the country the electricity supply authorities' difficulties continue to increase. Every time a power station or overhead line is planned protectors of amenities arise to oppose and delay and the Electricity Boards are unfairly stigmatised as "vandals." It would, of course, be feasible to place all these works underground—at a price; but the price would be such as to put the use of electricity out of court.

The Board's problems were dealt with in a paper read before the Town Planning Institute last week by Mr. Donald Clark, chief planning engineer of the Central Electricity Generating Board. In this the author traced the growth of electricity supply in this country, stressing its vital nature in the modern economy. He showed how the choice of power station sites was narrowed by technical and operational considerations, often forcing the Board to choose positions which are held to be beauty spots. Mr. Clark denied that stations were ever put in "real" beauty spots and only in "second-class amenity areas" when there was strong technical and economic justification. He deprecated indiscriminate opposition to a policy of discriminative siting. The public must be convinced that the electricity supply authorities do their best to give the least offence in the placing of their works and that they go to great lengths to ensure that their stations are inoffensive (or even attractive) in design.

IMPORTANCE OF MAINTENANCE

With the increase of mechanisation in all forms of industry and in the home, adequate maintenance programmes are becoming essential. Maintenance recommendations issued by manufacturers regarding their products vary in quality. In this respect, the motor car manufacturers are in the lead with their books of maintenance coupons. These ensure that every item receives its proper attention at the correct time. Preventive maintenance not only averts unnecessary breakdowns but, more important, it is a protection against the losses which would result from prolonged stoppages through breakdowns. Maintenance can be carried out at night or weekends but breakdowns often occur at the most inappropriate times.

In a large organisation, the maintenance department should have equal standing with the production team. If more than a few items of equipment have to be kept in running order, a well-organised maintenance system is required. The organisation of such a system, integrated with the production department, is described in an article in this issue. Although the author discusses the subject in relation to a generating station, much of the system is applicable to any large works.

ELECTRONICS IN INDUSTRY

The reluctance with which engineers, particularly those associated with heavy current engineering, have in the past accepted the use of electronic apparatus has no doubt partially arisen from the employment of new techniques coupled with the difficulty of visualising the minute quantities and times involved in the operation of electronic circuits, and partially from a not unnatural doubt whether such frail looking apparatus was in fact adequately robust. In an article in this issue (page 163) Mr. C. F. Brockelsby describes some of the more recent applications of electronic equipment in industry, both as an integral part of the manufacturing progress, in measurement and in plant control, and in so doing draws attention to three of the more important facilities offered by electronic apparatus: its high speed of operation, its ability to perform new functions by virtue of very high sensitivity, and its reliability.

These points are respectively illustrated by the rapid web inspection and automatic colour register adjustment in high speed rotary colour printing, the electrometer valve, sensitive to 10^{-16} A, and reactor control in nuclear generating stations, a problem which would be difficult to solve by other methods. In view of the physical and political consequences attendant upon a failure of the equipment in this last-mentioned application, some idea can be gauged of the confidence with which the latest products of one of the most rapidly expanding sections of the electrical industry are regarded today.

INTERNATIONAL TRACKING TEST USING AUTOMATIC APPARATUS

By N. PARKMAN*

Details of the new international test for tracking are discussed and an automatic apparatus for implementing the test,† suitable for use in industry, is described. The use of this apparatus, which was originally constructed for research purposes, is considered more practical than the manual method envisaged by the International Electrotechnical Commission (I.E.C.) and can be used to reduce the tedium and cost involved in a lengthy routine test

WHERE an electrically stressed insulating material is exposed to conditions which contaminate its surfaces, e.g. moisture or conducting dust, the tendency of the surface currents which flow to form conducting tracks is well known and of recognised importance.

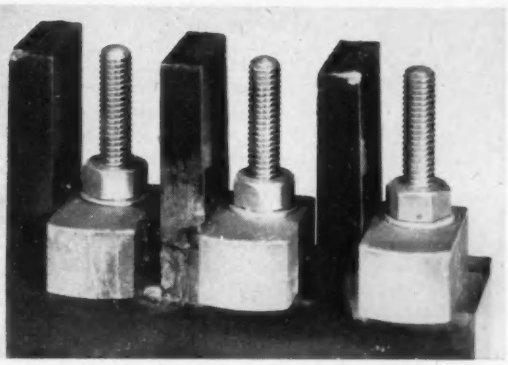
It is sometimes contended, however, that the incidence of tracking is insufficient for this form of failure to be of any real significance. This contention cannot be supported if one takes into account the true cost involved in the rectification of tracking faults. Fig. 1 shows two recent tracking failures. Fig. 1 (a) is part of a switch mounting such as is used in auxiliary control gear in generator circuits, in which tracking has occurred between adjacent contacts. This type of failure could lead to the forced outage of a generator at considerable expense to generating boards. This mounting is very widely used in the electricity supply industry, and a number of failures have been reported.

Fig. 1 (b) shows a moulded bar which carries the contacts of a control switch for a large 66 kV circuit-breaker. As can be seen, tracking took place between adjacent contacts with the result that the circuit-breaker closed unexpectedly. Fortunately, it happened to be a bus coupling switch, but had it been on a generator circuit the consequences might have been much more serious and expensive. The auxiliary voltage in this particular case was 240 V d.c. and the conditions in the switch house from which the sample was taken were by no means particularly adverse.

Although resistance to tracking does not always lend itself to precise measurement it has always been possible to discriminate between materials having good and bad tracking resistance. One of the earliest tests was the Detroit Edison Test which was modified by the Admiralty and became known as the Admiralty Test. The E.R.A. carried out further modifications to this rod/ring type of test, and the details of this test are shown in Fig. 2. The essentials of the apparatus are two concentric electrodes which rest on the surface to be tested. The electrodes are connected to a 230 V a.c. supply in series with an ammeter and a limiting resistor. The test consists of allowing drops of sodium chloride electrolyte, of stated concentration, to fall in the region between the rod and ring electrodes at the rate of one every 8 sec. When the damage done to the test surface by this treatment causes a current of about 1 A to flow continuously, the sample is said to have failed. The number of drops necessary to bring

* Electrical Research Association, Cleeve Road, Leatherhead.

† Based on E.R.A. Report L/T388. A provisional patent covers details of the apparatus.



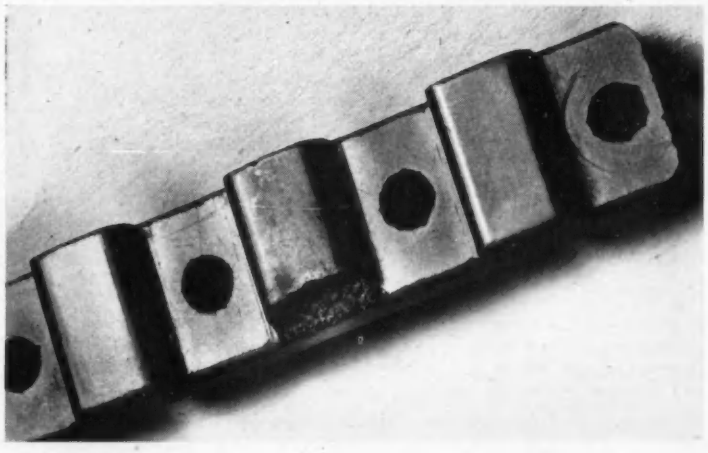


Fig. 1.—Recent examples of tracking failures showing (a) tracking in an auxiliary switch mounting and (b) tracking between the contacts of a circuit-breaker control switch

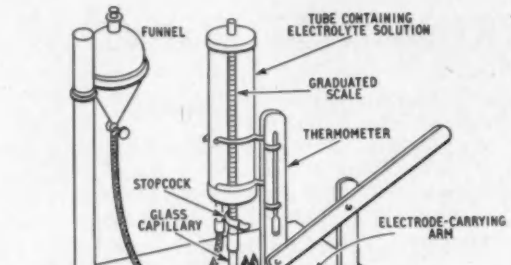


Fig. 2.—E.R.A. rod/ring apparatus

about this condition is then a measure of the resistance of the material to tracking.

A somewhat similar Norwegian test has become internationally accepted through the International Electrotechnical Commission, and this test is referred to in what follows as the I.E.C. test.

Until recently the only British Standard which included any form of track resistance test was B.S. 1322, and this was merely a simple "go or no go" test designed to discriminate between amino plastics and other materials with much poorer track resistance. However, the international test for resistance to tracking (I.E.C. test) is likely to appear to an increasing extent in the work of British manufacturers and users of dielectric materials in the near future. A form of the I.E.C. test already appears in B.S. 1645 "Domestic Electric Vacuum Cleaners" and in two other British Standards already in draft form. A similar test also appears in several specifications of the International Commission on Rules for the Approval of Electrical Equipment (C.E.E.), and in others in draft form. Compliance with the C.E.E. track resistance test is a legal requirement for importation of certain equipment into Scandinavian countries.

When it became clear some months ago that the I.E.C. test would be accepted as an international standard despite criticisms made by this country of certain aspects of the test, the E.R.A. started to develop an apparatus to be used for research purposes which would interpret the test in a reliable and practical manner, and make it less time-consuming. Experience with earlier forms of tracking tests and latterly with the I.E.C. test has resulted in the modifications outlined here being incorporated in an automatic apparatus. Some work has already been done on the effects of varying the electrode material and electrolyte in the I.E.C. test as it was then constituted.[1] This paper sets out and discusses details of the I.E.C. test and describes an apparatus which has been constructed for research purposes but can also be used commercially.

I.E.C. Test Method

Details of the apparatus suggested by the I.E.C. for carrying out the I.E.C. test are given in Fig. 3. Essentially, the test is similar to other drop-type tests, and consists of placing measured amounts of electrolyte between two electrodes resting on the surface to be tested, and noting the number of drops necessary to form a permanent conducting track at a given voltage. The following details complete the specification:—

(a) The electrolyte used is 0·1 per cent ±0·002 per cent ammonium chloride in distilled water.

(b) The drop size is 20+5 mm^3 −0.

(c) The drop frequency is one every 30 ±5 sec.

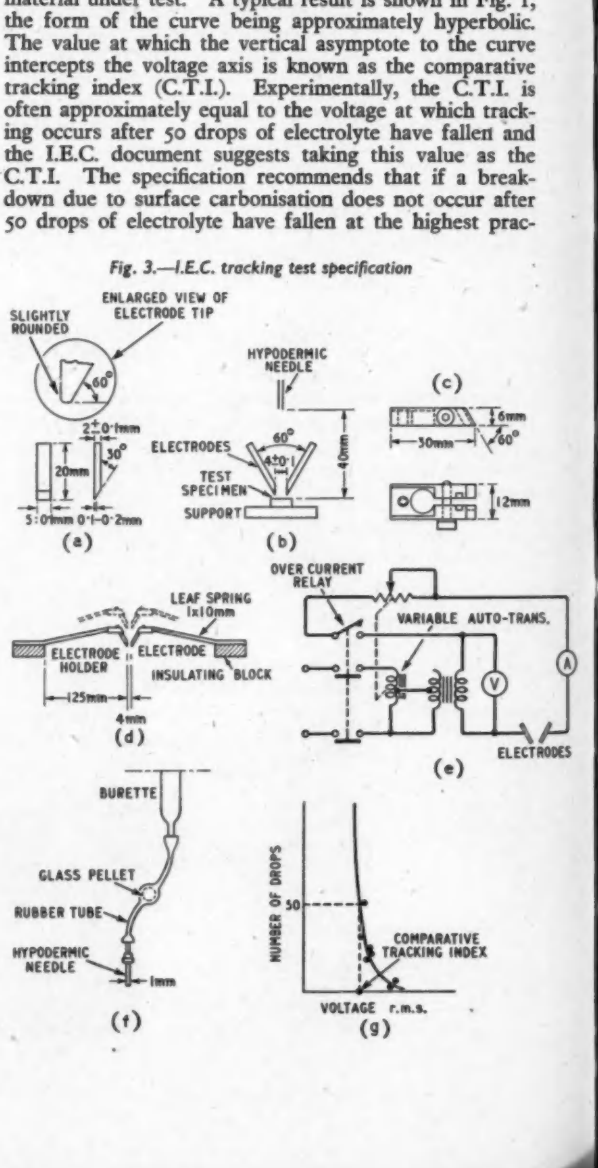
(d) For the electrode material, brass is recommended as a primary standard. Other metals may be used for special purposes. The use of platinum or platinum iridium is suggested for tests where the chemical influence of the electrode is to be avoided.

(e) Test voltages up to 1,000 V are normally used but the upper limit is not specified.

(f) The criterion for the end point of the test is the tripping of a 0·2 A overload relay in series with the sample.

The number of drops necessary to cause the formation of a permanent track is plotted against test voltage, using an uncontaminated part of the sample at each voltage. For many materials which form conducting tracks there is a sharp increase in the number of drops required to cause tracking below a certain voltage, depending on the material under test. A typical result is shown in Fig. 1, the form of the curve being approximately hyperbolic. The value at which the vertical asymptote to the curve intercepts the voltage axis is known as the comparative tracking index (C.T.I.). Experimentally, the C.T.I. is often approximately equal to the voltage at which tracking occurs after 50 drops of electrolyte have fallen and the I.E.C. document suggests taking this value as the C.T.I. The specification recommends that if a breakdown due to surface carbonisation does not occur after 50 drops of electrolyte have fallen at the highest prac-

Fig. 3.—I.E.C. tracking test specification



[1] Ives, S. C., Riley, M. M.—Society of Chemical Industry Symposium, April, 1958.

ticable test voltage, further tests should be made on a new sample of 1 mm thickness, with the metal test table (which is normally isolated) connected to that one of the electrodes around which least erosion has previously occurred. The series of tests at various voltages is then repeated, until breakdown to the table occurs by erosion after 50 drops have fallen.

Discussion of I.E.C. Test

The following discussion is intended to give readers, unfamiliar with the I.E.C. test, a critical background to the specification:—

Electrolyte.—It has been claimed that the main advantage in the use of aqueous ammonium chloride as the electrolyte for contaminating the surface under test is that all the NH_4Cl in each drop is completely removed from the region of the electrodes by sublimation due to the heating effect of the surface current. There is thus no tendency for the concentration of the electrolyte to increase due to evaporation of the water in each drop leaving a residue of the salt. The contaminating effect of successive drops of electrolyte therefore remains as constant as possible. On the other hand, NH_4Cl must be rare as a contaminant affecting insulation in service, and thus the use of NaCl, as in earlier tests, has much to commend it on practical grounds. It may be argued that where the contaminant used is a practical one, any peculiarities concerned with its use, such as increase in concentration, are relevant to service conditions. Certainly the danger in using an electrolyte rarely found in service is that the test can classify materials in a manner inconsistent with service experience. As an alternative to NaCl the use of a sulphate electrolyte as a surface contaminant has certain advantages in simulating conditions in industrial areas.

Some workers have used conducting dusts instead of an aqueous electrolyte to contaminate the test surfaces. This type of test is very useful for simulating certain service conditions, e.g. those occurring on insulators used in the overhead electrification of railways. However, dusts are unsuitable for standard test purposes, because of the difficulty in specifying a standard contaminating condition.

Drop Frequency.—In the older rod/ring type tracking test the drops of electrolyte fell at intervals of 8 sec. In the I.E.C. test the drop rate is less frequent, being one every 30 sec in the final draft. In earlier drafts the drop rate was one every minute but this was increased to make the test less time-consuming. The reasons for the longer interval between the drops are largely two-fold. First, there was the desire to ensure that each drop of the electrolyte had disappeared completely before another drop fell, so that the contaminating effect of each drop would remain as constant as possible. Secondly, since it is known that under most service conditions contamination and hence tracking, occurs at intervals, it is desirable, in order to simulate service experience as closely as possible, to permit the deleterious effects produced by a single contaminating drop to be completed before causing further contamination. During low-voltage tests on some materials the 30 sec interval between drops is not always sufficient to ensure that one drop of electrolyte has disappeared completely before another drop falls.

Electrode Material.—The original choice of platinum as a primary standard for the I.E.C. test electrodes was governed chiefly by the inertness of this metal. This should minimise complicated reactions between electrode, electrolyte and material, and also obviate the need for frequent regrinding of the electrodes. Work already carried out shows that in practice platinum is attacked during a test and that re-shaping platinum is rather more difficult than regrinding more commonly used metals. The I.E.C. test therefore now accepts brass as a primary standard. It is known that materials may be placed in a different order by the use of different electrode metals. In critical cases, therefore, tests should be made with the metal which is to be used in service. Since it is common practice today to plate base metals used as inserts in plastic materials with gold, silver, rhodium and palladium, it will be of interest to observe the effect of these electrode materials on the tendency to track.

The C.E.E. specifications normally require that the electrode material shall be sintered tungsten carbide, but it is likely that these tests will be brought into line with those of the I.E.C.

Test Voltage and General Procedure.—A major difference between the I.E.C. test and earlier ones is that in the former the time for the test is fixed, whereas in the latter the test voltage was fixed. In the case of the E.R.A. rod/ring system, mains voltage (230 V) was applied to the electrodes, and the time noted to produce tracking. The material was classed as non-tracking if it survived 1,000 sec with drops of electrolyte falling on it every 8 sec. The I.E.C. method on the other hand entails successive tests at different voltages in order to establish the voltage at which tracking occurs after 50 drops of electrolyte have fallen. The use of different voltages as a method for classifying materials has the advantage of removing part of the uncertainty involved in carrying out tests at a single voltage. Thus, a non-typical result is

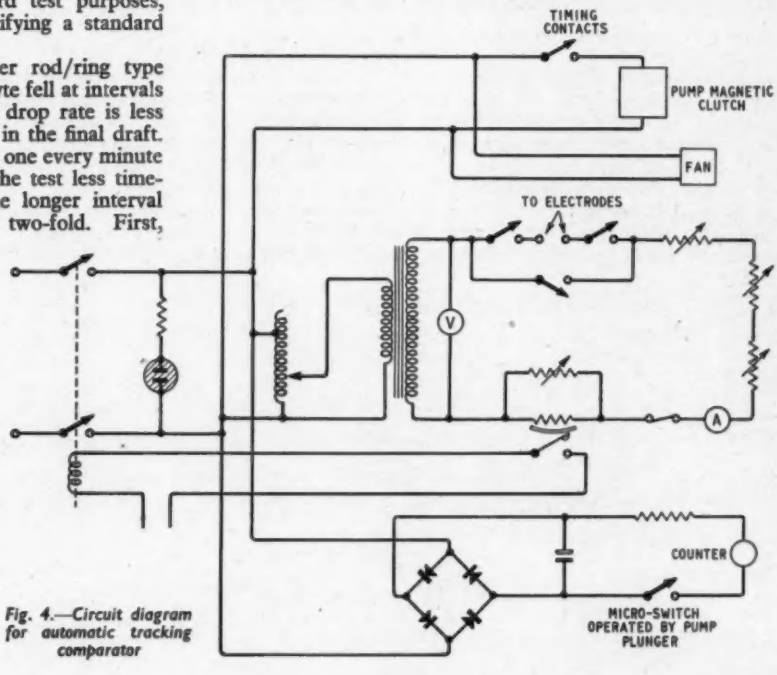


Fig. 4.—Circuit diagram for automatic tracking comparator

Fig. 5.—E.R.A. automatic tracking comparator

more easily recognised when a curve is drawn through a series of points. In addition, tests at higher voltages discriminate between materials which are all classed as non-tracking by tests at mains voltage.

Although the comparative tracking index (C.T.I.) is quoted as a voltage, its value should not be used to determine permissible stresses for design purposes, since the main purpose of the test is to classify materials.

E.R.A. Automatic Tracking Comparator

The circuit diagram of the new E.R.A. apparatus is shown in Fig. 4 and a photograph of the complete equipment in Fig. 5. The following describes its main features:—

The electrode arrangement is more practical than that suggested in the I.E.C. document. It is difficult to obtain consistent loading of the electrodes by use of leaf springs, since the loading changes as the electrodes penetrate into those materials which are rapidly eroded during the tracking test. The method of loading the electrodes by weights is easy to operate, and ensures a constant load on the electrodes regardless of their movement. The electrode holder is easily detachable but is held firmly in a fixed position during a test by a small grub screw in the load arm which fits into a recess in the stem of the electrode holder, as shown in Fig. 4. The sliding door on the front of the cabinet containing the electrodes actuates two micro-switches so that the electrodes cannot be live unless the door is closed. It will be seen from Fig. 3 that a high-voltage terminal is exposed in the front of the upper case. In commercial models the high- and low-voltage terminal sockets should be situated in the top of the upper case. A cabinet containing the electrodes could then have plug terminals in its base which would mate with the sockets without exposing live parts.

The drops of electrolyte are accurately metered and positively delivered at the specified rate to the surface to be tested. This is done by a micropump incorporating a magnetic clutch. The pump motor closes the magnetic clutch circuit once every 30 sec and so causes the pump plunger to operate. This system ensures a high volumetric efficiency for the pump. The amount of electrolyte delivered at each stroke is controlled by a micrometer head which limits the plunger movement. The stainless steel pump mechanism is available as a proprietary piece of apparatus.

This delivery system for the electrolyte removes several difficulties inherent in gravity-fed dropping systems. It is independent of ambient temperature and the head of electrolyte, and the quantity of electrolyte delivered after each time interval can be easily and accurately varied. By making the dropping tube of stainless steel hypodermic tubing and shaping it, as shown in Fig. 6, difficulties in maintaining drop rate due to condensation on the tube surfaces are minimised. Because the electrolyte is metered and delivered under greater pressure than with gravity-fed systems, the delivery can be nearer the specimen without becoming clogged by reaction products. The drop need only fall from about 1 cm or less, thereby removing drop " bounce " which has been noted by some workers.

The use of a pump for electrolyte delivery makes it easy to count automatically the number of drops delivered to the test surface. Each stroke of the pump actuates a microswitch in series with a magnetic relay counter. The counter can be re-set to zero, making it unnecessary to record initial readings.

The I.E.C. recommend the inclusion of a 0·2 A overload relay in series with the test sample. However, this has been found to trip due to transients while testing some materials, particularly at higher voltages. Transient currents exceeding 0·5 A commonly occur at the moment the drop of electrolyte falls between the electrodes, even though conducting tracks are not formed. The E.R.A. apparatus uses a thermal overload relay in parallel with a variable resistor of comparable resistance to that of the relay. This arrangement may be adjusted to trip with delays from 2 to 30 sec with fine adjustment and from 30 sec to infinity with coarse adjustment. This enables the apparatus to deal with a variety of materials whose tracking characteristics differ greatly. The " infinity " setting permits the initial short-circuit current to be set without tripping the overload relay.

Provision is made for connecting the testing table to either of the test electrodes, to permit discrimination between materials which puncture by erosion during the test and those which form conducting tracks on their surfaces. In the I.E.C. test (see page 158), this procedure is additional to the normal test for tracking and so extends a test which is already long. Provision has been made in the E.R.A. apparatus, for coupling the test table to the grid of a

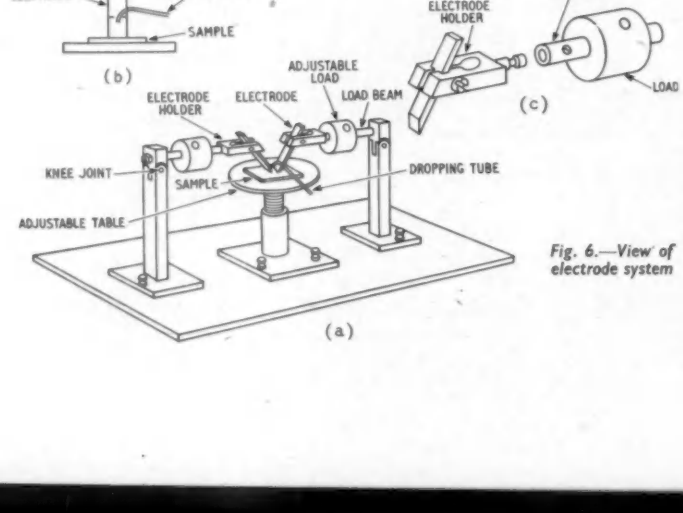


Fig. 6.—View of electrode system

thyratron in a simple trip circuit, and so assess by a single series of tests the tendency of materials to puncture or to track. This method of detecting puncture of the sample is more sensitive than that envisaged in the I.E.C. document and gives more consistent results. Thyratron trip circuits are frequently used in industrial laboratories, but the details of a simple circuit are included in Fig. 7.

Mode of Operation

With the "delay sensitivity" control set to minimum sensitivity the auto-transformer is adjusted to give the required test voltage. The shorting switch is then closed and the series resistances adjusted to give a current of 1 A. The shorting switch is then opened and the "delay sensitivity" control adjusted to the greatest sensitivity consistent with absence of spurious operation at the moment of fall of a drop. This depends on the characteristics of the material under test, and at the present time is best determined by the user. The pump is then switched on, the number of drops of electrolyte delivered to the test surface being recorded automatically. When the sample tracks, the thermal overload relay trips and the mains circuit is interrupted. If desired, a buzzer can also be operated. Further tests may then be carried out after resetting the counter.

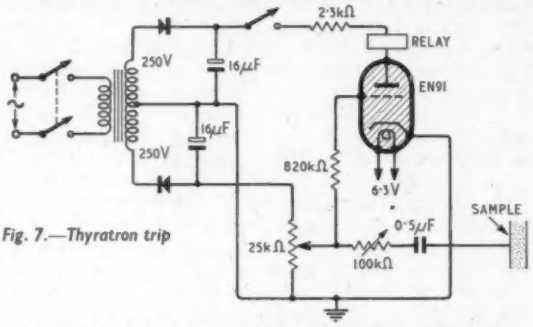


Fig. 7.—Thyratron trip

Fig. 8.—Commercial model of the E.R.A. tracking apparatus

The effects of the modifications incorporated in the E.R.A. apparatus are being examined in detail. It is intended to submit details of the improved apparatus to the I.E.C. in due course.

Southern Instruments, Ltd., Camberley, Surrey, a member of the E.R.A., is now producing a commercial version of the automatic apparatus described here. This is shown in Fig. 8.

The author is grateful to Mr. D. M. Cherry and Mr. A. W. Stannett of the Central Electricity Generating Board for providing the examples of tracking shown in Fig. 1, and to the director of the Electrical Research Association for permission to publish this article.

BRITISH ASSOCIATION AT YORK

THE annual meeting of the British Association for the Advancement of Science, being held in York for the sixth time, opened on 2nd September with a Council meeting and General Committee meeting, followed at the inaugural public meeting by the presidential address given by Sir James Gray, Professor of Zoology at Cambridge University.

Taking as his theme "The Proper Study of Mankind is Man," Sir James discussed the need for the sciences and humanities to seek common ground. This was reflected in two extensions of the Association's interests; the social as well as the natural and mechanical sciences were now included, and it was more concerned with the dissemination of scientific knowledge to the whole community. An important social aspect of science was its repercussions on international relationships. The discoveries of physics had frightened mankind and there were far too many people looking askance at science and wondering where it was leading. The factors which controlled human behaviour were not amenable to the laws of physics and chemistry, and the challenge was to the biological sciences, especially those dealing with the behaviour of organisms and their relationship to their environment. Speaking of the need for a wider outlook in the teaching of science, he said that the University College of North Staffordshire was leading the way by insisting that all students should survey the whole field of knowledge as a coherent picture in their first year before having specialised training in their three subsequent years. The strength of the older residential universities, however, lay in the extent to which students were given time and opportunity to educate themselves by contact with others having different interests and outlook.

A further report of the meeting in our next issue will cover those sections of the comprehensive programme of lectures, films and visits of interest to the electrical industry.

European Rural Electrification

IN its second annual report on the State of Rural Electrification in Europe, the Economic Commission for Europe analyses data received from governments in 21 countries regarding developments in 1957. The document of 61 pages is obtainable from the United Nations, Geneva, Switzerland, or from local sales agents at 3s.

It includes nine tables of statistics, which show that rural electricity consumption is, as a rule, growing faster than total consumption and that more electricity is used in rural areas for household than for actual farming purposes. Dairy farms usually possess more electrical equipment than other types. In some countries the overall rural figures are swollen by the use of electricity for grass drying and irrigation, the latter accounting for half the total consumption in agriculture in such cases. Trends in tariff rates and economic results obtained with different agricultural processes are given.

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

THE power characteristics of an induction motor with pulse speed control, using speed feedback for obtaining rigid mechanical characteristics, more particularly a relay system of automatic regulation of the motor speed on the "on," "off" principle, are analysed. The motor speed increases when the voltage is applied until at a certain value the input of the relay reaches the "braking" setting; this reduces the amplifier output voltage almost to zero. The motor speed falls until the resetting value of the relay is reached. The return of the relay into its initial position restores the amplifier output voltage to its maximum, the motor speed rises again, etc.

The load on the motor shaft is determined by the motor losses within the whole speed range. The losses and torques are calculated and the results checked by measurements on various types of induction motors, and the suitability of these types for work with this speed control determined. Comparisons are also made with d.c. generator-motor systems of speed control, showing that the pulse-controlled induction motor is preferable and cheaper. The efficiency of pulse-controlled motors is also independent of the load of the motor at a given speed.—"Power Characteristics of an Induction Motor in a Pulse Speed Control System," L. L. Rotkop, *Elektrichestvo*, No. 11, pp. 38-42, 1958, in Russian.

Air-Blast Circuit-Breaker Testing

The equipment for the development tests mainly comprises set-ups for mechanical measurements and, particularly, for pressure measurements. Three kinds of pressure pickups are used: differential and unilateral carbon pick-ups, and capacitive pressure "probes." To work at the h.v. level of the circuit-breaker, the pressure variations registered are fed in their electrical form to a frequency-modulated transceiver, and in another type to a microwave transceiver, when the pickup used is a cavity waveguide controlled by a dowel (piston) fixed to the membrane of the pressure membrane. The klystron transmitter works at 9,000 Mc/s, modulated for amplification at an auxiliary rectangular frequency of 30 kc/s. The movements of the arm of the isolator and of the breaker contact are now also recorded by an electrical pickup of potentiometer type operating an electromagnetic oscillograph. These measurements are accompanied by time measurements at every stage of the operation, and checks for mechanical deformations and alterations of the setting of the breaker elements during the durability test of 1,000 complete switching cycles ("CO").

The short-circuit, single- and three-phase, tests are carried out in strict compliance with the new Czech regulations which follow practically all the international recommendations in this field, on the basis of Gert's measurements of recovery and restriking voltage and frequency, amplitude factor, etc., in the Czechoslovakian power systems. For tests of physical interest an up-to-date slow-motion camera equipment for a maximum speed of 42,000 frames/sec and automatic cathode-ray oscillographs were provided, as well as peak voltmeters and c.r.o.'s for impulse phenomena with control by the phenomenon itself.—"Method of Development and Type Tests of Air-Blast Circuit-Breakers in the Lenin Works, Pbzen," K. Barta, V. Kulhanek and M. Vyleta, *Elektrotech. Obzor*, Vol. 48, No. 5, pp. 240-247, May, 1959, in Czech.

Inversion by a Contact Rectifier

The invertor operation of a contact rectifier, with a theoretical analysis, is considered, and the results of an experimental investigation of the operating characteristics of a contact-type invertor installation are reported. The essential advantages of this type of convertor equipment are its much higher efficiency than any other type, and the independence of the efficiency on loading (between 100 and 25 per cent) and voltage (between 800 and 100). Wide-range voltage control is possible and, except for the semiconductor type rectifier it has the smallest weight and space requirement of all rectifiers. No foundations are required, it is insensitive to vibration and temperature changes, requires no cooling for current outputs up to 1,000 A and is simple and reliable in operation, so that no supervision is necessary.

The contact-type invertor is in permanent readiness for starting, and long service life and continuous current loadings of 50 kA and more are possible. The commutation of the rectifiers or invertors of this type can still be improved by the use of premagnetised reactors where the phase of the premagnetising current is controllable.—"Inversion of D.C. into A.C. by a Contact Rectifier," D. A. Zavalishin and A. K. Mikhailov, *Izv. Akad. Nauk, Otdel Tekhn. Nauk* (Power Engineering and Automation), No. 2, pp. 93-98, 1959, in Russian.

Parallel Operation of D.C. and A.C. Lines

The lines considered are both supposed to operate as links between two a.c. power systems. In steady operating conditions, the load of the d.c. link depends on seven parameters which, however, reduce to two parameters if the effect of the a.c. frequency on the near- and far-end reactances (transformers) of the d.c. line are neglected. The synchronisation of the systems by the a.c. transmission is considered first, and then the regulation of the power transmitted and its distribution on the d.c. and a.c. link lines.

The qualitative control of the voltage and maintenance of the stability of the a.c. transmission depends on the maintenance of a given ratio of in-phase and quadrature VAr which is usually achieved by regulation of the synchronous condensers or shunt reactors and capacitors, but in the a.c.-d.c. parallel transmission this may be effected by a compensation of the capacitive or inductive excess by the d.c. line elements. The lockout effect of the d.c. line for follow-up currents from the power systems is particularly important in the case of short circuits in one of these systems. It is also shown that the d.c. link improves the synchronous stability of the whole system.—"Some Considerations on the Parallel Operation of D.C. and A.C. Transmission Lines," S. R. Buachidze, *Elektrichestvo*, No. 5, pp. 54-56, 1959, in Russian.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

Industrial Electronics

THE PROSPECTS FOR EXPANSION

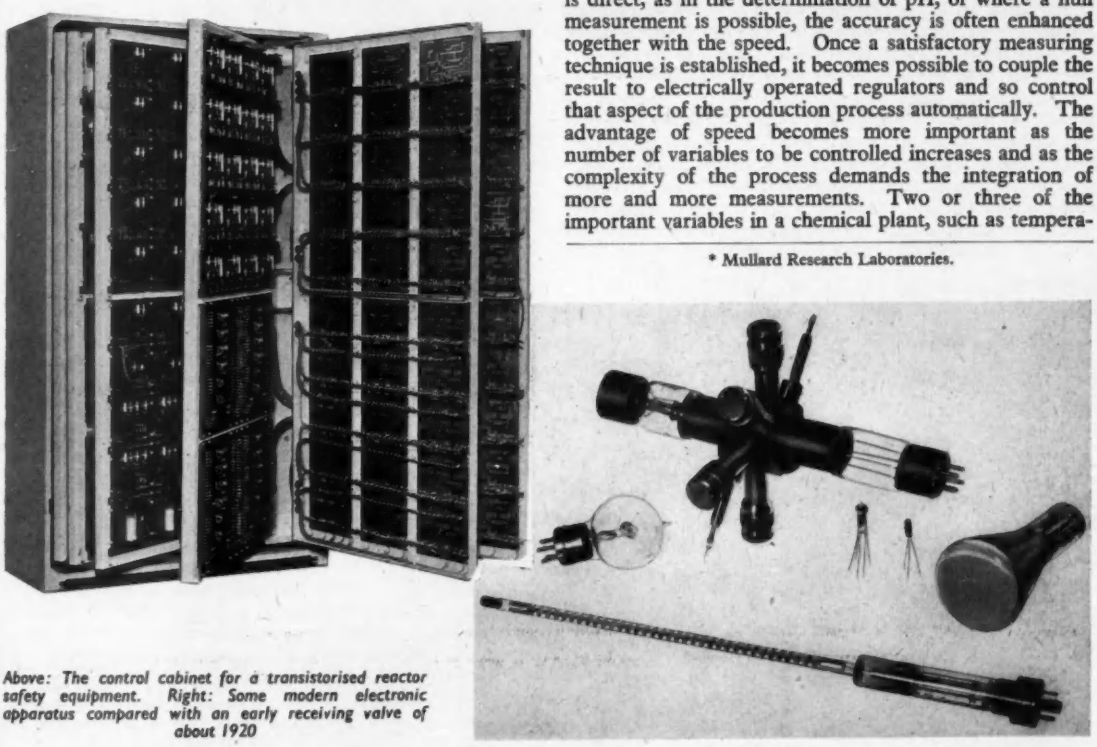
By C. F. BROCKELSBY, A.R.C.S., B.Sc.*

The use of electronic apparatus in industry is steadily growing and, as new equipment is continually being developed to carry out new functions or improve the efficiency of those carried out by alternative means, its use will continue to grow. Some of the latest applications of this type of equipment in the two main fields in which it is applied, the measurement and control of plant and as part of the manufacturing process, are described in this article

THE field of science, engineering and technology now called "electronics" may be said to date from the invention of the thermionic valve, not much more than half a century ago. There was already a well-developed light electrical engineering industry, especially in the field of communications—the telegraph and telephone—and it was in this field that the new science of electronics found its first practical application. Radio communication was developed, conveying both messages and entertainment, and a thriving industry resulted from the demand for components and equipment, mainly for domestic radio and television. It was not long before the new techniques were applied to industrial purposes also. The development of measuring instruments for use within the communications industry soon led to the application of allied techniques to the problems of inspection, measurement and, later, automatic control arising in industry generally. At the same time, electronic methods began to be applied in the industrial process itself, e.g. in radio frequency heating. The intensive, if specialised, development of electronics under the impetus of war, coupled with the satisfaction of the more urgent customer demand for domestic equipment, has paved the way for a very large expansion of industrial electronics in the immediate future.

Electronics has three facilities to offer in the industrial field. In the first place, electronic apparatus operates at high speed. A familiar simple example is in the estimation of moisture content. The conventional laboratory procedures of weighing and oven drying take time, but an electronic moisture meter gives an almost instantaneous result. In this particular example there may be some loss of accuracy because the measurement is indirect, since the moisture content is estimated through its statistical correlation with some electrical property such as conductivity. Where the electronic measurement is direct, as in the determination of pH, or where a null measurement is possible, the accuracy is often enhanced together with the speed. Once a satisfactory measuring technique is established, it becomes possible to couple the result to electrically operated regulators and so control that aspect of the production process automatically. The advantage of speed becomes more important as the number of variables to be controlled increases and as the complexity of the process demands the integration of more and more measurements. Two or three of the important variables in a chemical plant, such as tempera-

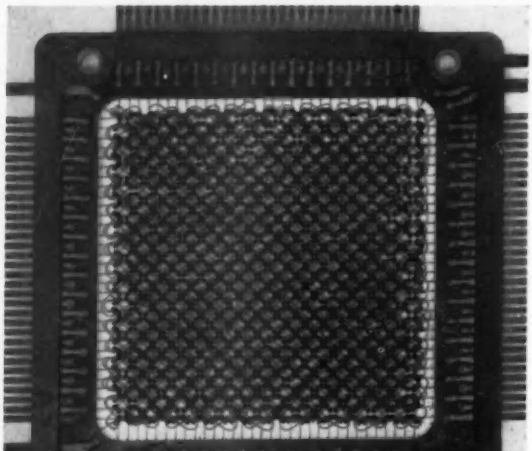
* Mullard Research Laboratories.



Above: The control cabinet for a transistorised reactor safety equipment. Right: Some modern electronic apparatus compared with an early receiving valve of about 1920

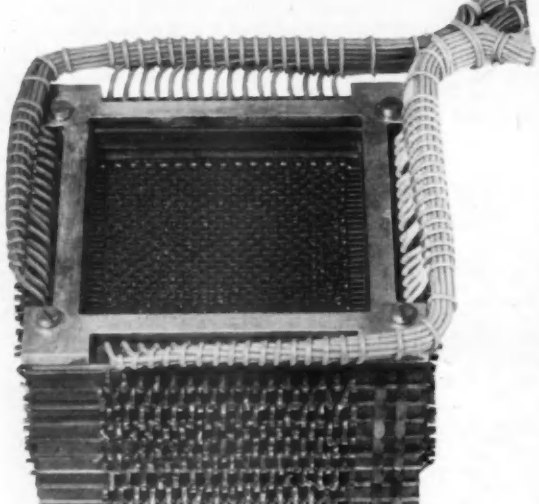
ture, pressure and flow, can often be adequately controlled by pneumatic devices because the process time constants may be of the order of 10 minutes. The continual automatic adjustment of the register of successive colours in a rotary colour printing machine, however, requires the inspection of a paper web moving at high speed and a correspondingly rapid adjustment which is only possible electronically.

This illustrates the second facility offered by electronic devices: they not only perform existing tasks more satisfactorily but also carry out quite new functions. The photo multiplier cell, sensitive to a few quanta of light, and the electrometer valve, sensitive to 10^{-16} A, are familiar examples of devices which extend the range of application for electronic apparatus. But none of these would be of any use without the third facility: reliability.



A matrix plane of square-loop ferrite rings for a computer measuring system and . . .

. . . ten planes connected in a single stack



The early essays into industrial applications of electronics were not marked by a high standard of reliability. This was due to the imperfect development of the electronic parts themselves, and the comparative inexperience of the engineers concerned. Nowadays, electronic valves and components have been developed with such reliability that repeater amplifiers can be—and are—submerged beneath the Atlantic for many years to provide a telephone link with the United States.

The development of solid state devices, such as the transistor, has contributed largely to the attainment of such reliability. One field in which their simplicity and reliability makes them most attractive is sequence control —the control of the sequence of a number of operations. A simple example is the modern automatic passenger lift, which accepts calls to and from several floors simultaneously or in sequence and selects the most economical route to satisfy them, while more advanced examples occur in manufacturing plant. The absence of moving parts and electrical make-and-break contacts gives the transistor a striking advantage over electro-mechanical contactors.

A field calling for the utmost reliability is the control of nuclear reactors in power generating stations. For example, the activity of each fuel canister, as evinced by its temperature and rate of change of temperature, should ideally be continually supervised, neither failure to indicate nor any false alarm being permissible. Several hundreds of individual recorders would not offer an acceptable solution, but this can, however, be obtained by a recently developed all-transistor system which scans the signals from banks of thermocouples, extracts the rates of change and presents the information in an assimilable form to the control engineer, giving warning of any deviation from prescribed conditions and initiating a shut-down if danger limits are passed. The system is completely self-checking and almost immune from faulty operation. Similar techniques can, of course, be applied to other reactor parameters and in other fields.

This ability to handle, digest and process rapidly large quantities of data not only facilitates the task of engineers supervising and controlling complicated processes, but leads to the automatic performance of tasks otherwise requiring the co-operation of a large team of men and it is clear that completely automatic production units will come into being in the near future.

The large electronic computers using thermionic valves, developed for scientific purposes, are already being replaced by computers using solid state devices, e.g. transistors, as the active elements and square loop ferrite rings as passive "memory" units. The matrix plane of 32 by 32 square loop ferrite rings illustrated is for a computer measuring system. The matrix works with numbers expressed in the binary code, and each ferrite ring is capable of storing, in the form of remanent magnetism, one digit or item of information. Ten planes of these rings connected in a stack have a total storage capacity of 10,240 digits. These smaller and more reliable units are already in use for cost, wages and stock calculations, and they are now being offered in the United States for industrial process control. At the I.S.A. Instrument Automation Exhibition held in September, 1958, no fewer than five leading industrial instrument firms were showing systems of this kind. A single computer of reasonable size can handle so much data that it can not only regulate numerous "environmental" controls, maintaining prescribed temperatures, pressures, etc., but can also assimilate information about the broader aspects of the production process—such as total efficiency—and modify the control programme to

The nuclear magnetic resonance spectrum of ethyl alcohol

optimise the overall result. If the behaviour of the process is well enough understood to be expressed in mathematical equations it is a comparatively straightforward matter to programme a computer for such optimising control, but if not, a rather larger machine is necessary to give such control by, for example, successive approximation or relaxation methods.

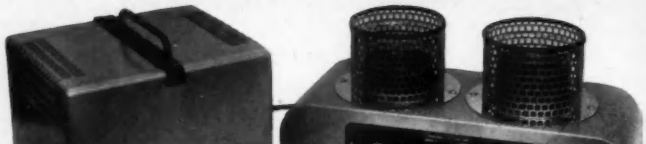
All the information to be handled by the computer must, of course, be translated into the machine's own digital "language" and the output must be translated back again. There is a large field of development open in the provision of these input and output devices. On the input side, one approach is to use existing, well-tried primary elements for actually measuring the process variables, and these transducers can usually be made to deliver an output in the "analogue" form of a voltage proportional to the quantity being measured. This is then translated to suit the computer by an "analogue-to-digital convertor." This approach is not always satisfactory or even possible and new primary measurements are being developed from electronic techniques.

An example of this process, which also indicates the rapidity with which fundamental research is nowadays carried through the stages of development and engineering into a final stage of industrial application, is in the recent extension of spectrometric techniques. Spectrometry with visible light has long been a standard method of qualitative and quantitative chemical analysis, and infra-red and ultra-violet spectroscopy also have their established place in industrial techniques. Within the last few years a new field of high-resolution spectrometry has been developed, using radio frequencies in conjunction with magnetic fields. Two types of r.f. spectra are being increasingly employed in research and will soon enter the industrial field as well, electron spin resonance, "e.s.r.," and nuclear magnetic resonance, "n.m.r.," spectrometry.

The nuclei of about half the elements have both angular momentum—spin—and a magnetic moment, behaving like spinning magnets. If placed in a uniform magnetic field they precess about the field direction just as a spinning top precesses about the earth's gravitational field. If a rotating magnetic field is superimposed, energy will be absorbed from it when its frequency coincides with the precession frequency, and there will be a "nuclear magnetic resonance." In a given polarising field, the resonant frequency is characteristic of the nucleus; for example, the proton or hydrogen nucleus resonates at about 40 Mc/s in a field of 1 weber per square metre. The absorption spectrum thus provides a method of analysis. Water, for example, can be estimated in solids by observing the proton resonance, and this is still possible even if the solid contains combined hydrogen, because the spectral line is much narrower in liquids than in solids and so can be distinguished. As the resolution of an n.m.r. spectrometer is increased, the fine structure of the spectrum is progressively revealed. The disposition of the valency electrons around the spinning nucleus produces a local perturbation of the magnetic field, so shifting the resonance frequency slightly; this "chemical shift" gives information about the radical of which the nucleus is part. In the illustration showing the n.m.r. spectrum

A nuclear magnetic resonance spectrometer

Above: An ultrasonic cleaning plant incorporating a conveyor



Right: Small components may be cleaned in this low power ultrasonic unit

of the protons in ethyl alcohol, the chemical shifts produce the three main "lines" which correspond to the three different states of combination of the hydrogens shown in the structural formula $CH_3 . CH_2 . OH$. It will be seen that each of these "lines" has a still finer structure: the CH_3 line is a triplet, the CH_2 line is a quadruplet, and the OH line a singlet. This hyperfine structure gives additional information about the molecular structure. Very refined techniques are needed to obtain such high resolution, the width of the fine lines in this spectrum is about 0·5 milligauss in a field of about 8,000 gauss—a resolution of better than 10^{-7}, calling for a corresponding precision and uniformity in the radio frequency and the field of the polarising magnet. It will be some time before such resolution is attainable on the production line, but it is already possible to measure n.m.r. spectra of moderate resolution on continuously flowing liquids under production conditions. This has obvious applications in such fields as the oil industry.

The other field of r.f. spectrometry, e.s.r., is of more interest in studying solids. In magnetic fields of equal strength, electron resonance occurs at much higher frequencies, in the microwave region, and all the experience gained in the development of centimetric radar equipment is being applied to this new purpose.

Enough has been said to show that electronics still has an expanding part to play in industry in the fields of measurement and control which, because they turn on the accumulation and handling of numerical information, are likely always to be the fields where electronics makes its main contribution. It has also, however, something to contribute in the actual manufacturing process. Ultrasonics, for example, are mainly used for inspecting metals for internal flaws, but an important application involving high power equipment, which is fully established in the U.S.A. and is rapidly coming into favour in this country, is in the cleaning of fabricated parts and mechanisms. The intense scrubbing action of ultrasonically induced cavitation in a liquid can produce a state of cleanliness unattainable by any other physical means. Manual and conveyorised plant of British design and manufacture for this process is already available and will certainly find increasing application in the future. A recent addition to the applications of high power ultrasound is welding. Ductile metals, such as aluminium, can be cold pressure welded but only with large deformation—up to 60 per cent reduction in thickness. If, however, intense ultrasound in the form of a tangential vibration is applied to the interface, a cold weld can be made at much lower pressure and with only slight deformation. One interesting feature is that welds can readily be made between metal pieces which may be very thin—down to a few microns, very unequal, from 1 thou foil to 0·25in sheet—and of different metals, such as copper and aluminium.

It is not possible in a short article to do more than indicate a few of the more interesting trends and developments which are taking place in this expanding field, but the broad outlines of the situation are plain. Industrial electronics has grown up: it is now a quite important industry in its own right and it will play an increasingly responsible part in the improvement of productivity in every branch of commerce and industry.

The author wishes to thank the directors of Mullard, Ltd., and the director of Mullard Research Laboratories for permission to publish this article.

Hydraulics Research

IN the annual report of the Hydraulics Research Station, Wallingford, Berks, published for the Department of Scientific and Industrial Research by H.M. Stationery Office, price 5s 6d, details are given of a large-scale model of the Severn estuary constructed to study the problems of the abstraction and return of cooling water for nuclear power stations. These include the siting of inlets and outlets to prevent recirculation, the exclusion of bed material from the intakes and the assessment of possible changes in the temperature of the water in the estuary.

Scale model studies in connection with four hydroelectric schemes are described. Of these, three were at the request of British consultants responsible for projects in Greece, Malaya and Venezuela. The fourth was a model investigation in connection with the proposed pumped-storage scheme at Blaenau Ffestiniog in North Wales. This scheme is associated with the nuclear power station at Trawsfynydd. The energy supplied by the generating station during periods of low demand will be used to pump water from a lower to a higher reservoir and at peak periods the head of water created will be used to generate additional electricity. The Hydraulics Research Station was asked to investigate the possible effects on the lower reservoir of normal and emergency operations of pumps and control valves. The tests showed that no troublesome surges should occur, but they indicated that modifications to the intakes were desirable to prevent air being entrained in the pumps.

VIEWS on the NEWS

By REFLECTOR

A PRETTY problem has arisen in the matter of street lighting in the Isle of Man. The Ramsey Town Commissioners have a contract with the Isle of Man Electricity Board for the lighting of their streets from half-an-hour after sunset. They have just discovered, it appears from a report in the *Isle of Man Weekly Times*, that "sunset" is related to Greenwich and not to local conditions and therefore the Commissioners have been paying for a lot of unnecessary light. The Commissioners have now arranged a new agreement and expect to save about 150 hours of lighting during the current year. They are suggesting to the Electricity Board a rebate for the superfluous light they have had.

* * *

Mr. J. F. Perrin, of Welling, Kent, having read my note on the Harness belt in the *Electrical Review* of 21st August, has sent me a pamphlet, published around 1893, advertising a similar device. In this it was claimed that

> "nervous and organic derangements . . . which completely baffle ordinary treatment, readily yield to the magic influence of electricity as generated by Dr. Carter Moffat's featherweight body belt."

And all this for only 5s 6d. As testimony to the genuine nature of the belt, several letters from satisfied customers are reproduced but, above all, it is stated that "H.M. the King of Italy has conferred a gold medal and diploma of honour on Dr. Carter Moffat."

* * *

The arrival of a public supply of electricity was celebrated (says the *Western Morning News*) at a party at a remote mansion in the heart of the Devon countryside—Shepleigh Court, Blackawton. The mansion has been converted into a hotel for sunbathers, and the owner explained that this did not mean that they were nudists: "We are people who like sunbathing without clothing." South Western Electricity Board officials were among the guests and so I am relieved to learn that "normal clothing was worn by all those present."

* * *

Brushing aside the virtues of the trolley-bus as comparatively insignificant against its disadvantages, the *Belfast News-Letter* heads a leader on the withdrawal of these vehicles "No Tears for Belfast Trolley-buses." To bolster up its views it makes a number of questionable accusations. The trolley-bus, it is said, "is apt to throw its passengers about," as though bad drivers were unknown on motor-buses. "It takes up a lot of room on the road," as if it took up any more room per passenger than the motor-bus. "It is very slow on corners" (is this a fault ?) and it is "deceptively fast on the straight" (whom does it deceive and why shouldn't it travel quickly on the straight ?).

* * *

An article in the July *Journal* of the Engineers' Guild deals with the recruitment of members into the Guild. In an introduction to the article it is said:—

> "One step which has recently been taken is to circulate a sample of potential members to find out their views about the Guild and the profession."

In the course of their circulation these people should themselves find out a lot.

* * *

"High-Strength Insulators Defy Duffers" says a headline in the *Electrical World*. The "duffers" are golf players who slice their drives on a Los Angeles golf course where one of the hazards is a 148ft high transmission line tower. This they do quite often, with the result that supply failures have been commonplace. Engineers of the local Power and Water Department who investigated the matter had the unusual task of devising laboratory apparatus to simulate the effect and they discovered that standard insulators were unable to withstand the impact where the speed of the golf balls was over 80 ft/sec. High-strength types with a minimum impact strength of 150 in-lb were therefore substituted and now a direct hit is no longer signalled by a power cut in the pavilion.

* * *

Seventy years ago when the electrical industry, as such, was yet unborn the *Electrical Review* discussed the prospects for men embarking upon an electrical career. In the issue of 6th September, 1889, it said:—

> "Electricity has great and varying branches, and the lighting of England will act as an invigorating stimulant to the various industries in connection with electricity. The use of the motor for workshops appears to be little understood and consequently it is rarely adopted. In this branch of electrical power alone there are many opportunities, while another distinct branch will be the application of electricity to the purposes of locomotion. In fact there will be no limit to the application of electricity. But only good men will get good places, and only hard study in both school and workshop will produce good men."

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Is This Fair Trading?

YOUR leader on "Electrical Fair Trading" draws attention to a situation so anomalous that to avoid a charge of hypocrisy the adjective must surely be at once dropped. Accepting the wisdom of making the policy a code of ethics and guidance for voluntary adoption, it is quite damnable that the terms to be given (out of the trade discount) are now left for decision by the manufacturer or supplier concerned. In other words, a contractor or retailer has no say in how much of the trade discount is to be left in the hands of the trade, even though he has put in considerable work in order to get the business. Fair trading indeed!

My company has now had many experiences of trying to secure business where much has been done in designing both lighting and heating schemes, only to find that "the decision of the manufacturer" may leave a gross profit on the merchandise concerned of some 5-7 per cent. Our protestations produce sympathetic noises and, may be, an offer of a further 2½ or 5 per cent, but frequently much more than this has already been spent in planning and selling the scheme. The difficulty of the manufacturer is, of course, obvious, since if the terms he offers are bettered by another manufacturer, then he loses the business, no matter what happens to the contractor.

Over a decade ago I urged that those outside the electrical industry who thought they were entitled to discount concessions from those of us in the industry, should formalise their request and give the evidence we can reasonably require in order to support their claims. Successful applications should be given a code number, to be quoted by all concerned on all the orders involved, and the discounts given should be shared fairly by each section of the trade—contractor, wholesaler and manufacturer. Any procedure short of this general approach does not seem to me to be entitled to use the word "fair."

London, E.C.4. J. MORTIMER HAWKINS,
Managing Director,
Mortimer, Gall & Co., Ltd.

The Harness Belt

I READ with interest "Reflector's" note regarding Mr. Harness's electric belt in your last issue.

During recent structural alterations at premises in Chiswick a copy of the *Evening Standard* for 24th February, 1890, came to light. Whilst reading this most interesting relic today, I was amazed to find an advertisement (practically the whole page) for Mr. C. B. Harness of the Medical Battery Co., Ltd.

The advertisement consists of a series of extracts from letters and reports and is headed "An Honest Statement regarding the genuine curative value of Harness Electropathic belts." It would appear to be effective for paralysis, rheumatism, gout, writer's cramp and (very delicately put) "ladies' ailments."

Mr. Harness is described as the President of the British Association of Medical Electricians and President of the Electropathic and Zander Institute. Presumably these admirable institutions are now merged into the I.E.E., or, perhaps, the E.T.U.

Chiswick, W.4. E. C. WALFORD,
Branch Commercial Superintendent,
Ealing District,
Southern Electricity Board.

Fissile or Fissionable?

YOUR leader "Reactor Policy" in the issue for 21st August, contains in the first line the word "fissionable."

Surely no such word exists and possibly what was intended was "fissile"?

London, S.E.1. J. M. CRANMER.

[The "Concise Oxford Dictionary" allows both terms. "Fissile" is defined as "cleavable, tending to split." Under "Fission (Also, Chem.)" the Dictionary gives "Splitting of atom. Hence ~able."—Editors, *Electrical Review.*]

Electrification of Valence-Avignon Line

FRENCH RAILWAYS announce that the electrification of the 78-mile Valence-Avignon section of the Paris-Marseilles line will be completed in time for all main line expresses using this line to be electrically hauled between Paris and Avignon (a distance of 461 miles) when winter time-tables are introduced on 4th October.

This will make possible a considerable degree of acceleration on overall timings of main line expresses between Paris and Marseilles or Ventimille. The "Mistral" express, for example, will cover the 536 miles between Paris and Marseilles in approximately 7½ hours at an average speed of 71 m.p.h. and the 676 miles between Paris and Nice in approximately 10½ hours at an average speed of 64½ m.p.h.

Approved Electrical Contractors

IN its progress report for the second quarter of this year the National Inspection Council for Electrical Installation Contracting notes that the third edition of the Roll of Approved Contractors issued in May contained just over 5,250 names, against just over 5,000 in the previous edition. Of the 17,500 copies printed over 12,500 were supplied gratis to interested authorities while most of the balance was sold, chiefly to manufacturers.

Seventy-eight applications for enrolment were received during the quarter; 77 applications were approved; 55 were deferred for further inspection; seven were rejected; and 42 firms were removed from the Roll, mainly because they had either gone out of business or had given up electrical installation work.

It has been agreed in principle that there shall be direct representation of the Scottish Committee on the Board. That Committee was asked by the Secretary of State for Scotland to suggest suitable persons to serve on the Building Standards Advisory Committee set up under the Building (Scotland) Act.

The annual general meeting is to be held at the Connaught Rooms, London, W.C.2, on 13th November; it will be followed by an informal discussion and luncheon.

The technical section of the report says that although the general improvement in the standard of work inspected has been maintained, there is no marked reduction in the scope of common faults which are reported. The majority of approved contractors now possess appropriate testing equipment. Inspections of new applicants during the quarter numbered 137, including second inspections of deferred applicants. There were altogether 1,419 routine inspections.

WELDING AT HUNTERSTON

Pressure Vessels and Heat Exchangers

AT a welding school established by the Motherwell Bridge & Engineering Co., Ltd., at the Hunterston nuclear power station being built for the South of Scotland Electricity Board by the General Electric Co., Ltd., in collaboration with Simon-Carves, Ltd., welders have been trained in the welding of up to 3in thick steel plates for the 70ft diameter pressure vessels and other parts of the gas circuit. The steel chosen for fabricating the pressure vessels, an aluminium-killed low-carbon high-manganese steel manufactured by Colvilles, Ltd., possesses good welding properties, since its carbon content is less than 0·16 per cent. The "Diadem" opal electrodes made by Cooper & Turner, Ltd., chosen for use with this steel are stored before use in a constant temperature and are carried during site use in electrode dryers or heated quivers drawing current from the welding supply through a single pincer-type contact.

The six component strakes for each sphere are welded under temperature controlled conditions in four 80ft diameter enclosures, with final circumferential welding to form the spheres taking place inside the reactor's concrete biological shield. To obtain a high quality finish on the welded surfaces for both maximum clarity on X-ray examination and to prevent cold cracking, Consolidated Pneumatic "Hicycle" high frequency electric grinders are employed. Four 400 kV Pantak X-ray machines are used for final weld inspection in the 2⅞in thick steel pressure vessel, and one 300 kV unit and three 220 kV units are used in the main welding shop. Surface grinding flaws of the order of $\frac{1}{300}$in, in addition to the most minute welding flaws, can be detected.

Heat Exchanger Construction

Sixteen cylindrical heat exchanger vessels, eight for each reactor, will be fabricated in the welding shop, each 73ft 6in high by 19ft 6in diameter and weighing 200 tons. Two Quasi-Arc-Union-Melt tandem head machines are used, with single-wire welding. Part-fabricated materials received from Motherwell are assembled, welded by the tandem head machines and given X-ray examination. The bottom and top head and supporting skirt are manually welded before being matched to the main cylindrical shell, as are the thermal sleeves, nozzle branches and external and internal support lugs. The completed shell is moved on four 300-ton bogies to the stress-relieving furnace, fitted with internal baffles to control the gas flow and lagged with 4in thick "Rocksil" rock wool manufactured by the Cape Asbestos Co., Ltd. After stress relieving, a hydrostatic test using sea water is carried out and the vessel is cleaned. When the machining operations, including drilling the tube element holes in the ends of the thermal sleeves and machining the flange faces of the blower motor nozzle, are finished, the internal structure is fitted temporarily for adjustment. Final assembly is carried out under a high degree of cleanliness, a clean conditions chamber incorporating changing rooms being connected to the vessel. The cleaned internal structure is fitted, and the vessel cleaned and sealed, ready to be placed in its final position.

When the second of the two reactors goes critical in 1962, over 9,000 tons of steel will have been welded in fabricating the two pressure vessels, the gas circuits and the steam raising units, involving the use of some 150 tons of weld metal.

Grinding a completed weld on one of the heat exchanger vessels, using Consolidated Pneumatic "Hicycle" equipment

Work in progress at Hunterston nuclear power station

PERSONAL AND SOCIAL

News of Men and Women of the Industry

H.R.H. the Duke of Edinburgh has accepted an invitation to become the first Honorary Fellow of the Illuminating Engineering Society.

Mr. K. Fearnside, M.A., A.M.I.E.E., A.F.R.Ae.S., has been appointed to the board of Smiths Aircraft Instruments, Ltd., as director of research. Formerly research manager at the company's Cheltenham factory, he will continue to have charge of research activities in his new appointment. Mr. Fearnside was educated at Scarborough High School and St. John's College, Cambridge, graduating with first-class honours in both parts of the Natural Sciences Tripos and being awarded the Hocken prize in physics. From 1940 to 1946 he served in the R.A.F. as a signals/radar officer and was demobilised with the rank of squadron-leader. He then joined the Atomic Energy Research Establishment, Harwell, where he did work in basic nuclear physics and the application of radioactive isotopes for industrial purposes. His next appointment was in 1950 as technical director of Isotope Developments, Ltd., and in 1953 he joined Smiths Aviation Division to take charge of systems studies in the newly formed Guided Weapons Department. As research manager he has been in charge of the Research Department for the past two years.

Mr. K. Fearnside

In our 14th August issue we gave a list of the principal appointments under the A.E.I. reorganisation and last week we published short biographies of the general manager and regional managers of home district offices. The following notes relate to divisional management appointments:—

Electronic Apparatus Division.—**Mr. E. Alexander,** A.M.I.E.E., general manager, joined the B.T.H. Co., Willesden, in 1924, and was appointed factory superintendent in 1937, general superintendent in 1946, and manager in 1955.

Mr. V. M. Roberts, O.B.E., B.Sc., A.M.I.E.E., commercial manager, who started with B.T.H. in 1924 as a student apprentice, was appointed manager, B.T.H. Electronics Sales Department, in 1946. He is a director of B.T.H. Sound Equipment, Ltd.

Mr. A. L. Whiteley, D.Sc., M.I.E.E., chief engineer, served a student apprenticeship with B.T.H. and in 1932 was awarded a fellowship which enabled him to spend a year with the G.E. Company, Schenectady. Returning to Rugby, he was, from 1934 to 1942, in the Industrial Engineering Department and in 1945 was appointed manager of the Electronics Engineering Department.

Mr. A. G. Barton, A.M.I.E.E., divisional executive (Manchester), joined M-V as a school apprentice in 1939 and after war service returned to the company as sales engineer. In 1958 he was appointed sales manager, Electronics Department.

Mr. E. T. W. Barnes, A.M.I.E.E., manufacturing manager, since completing his apprenticeship with Metropolitan-Vickers, has been continuously engaged on the manufacturing side. In 1948 he became assistant superintendent, Instrument and Meter Department; in 1953 superintendent, Radio Department; and in 1957 superintendent, Electronics Department and Leonard Works.

Motor and Control Gear Division.—**Mr. J. G. Boddy,** B.A.(Cantab.), Associate I.E.E., M.Am.I.E.E., general manager, served a B.T.H. student apprenticeship and was later on the staff of the Manchester district office. He was seconded to the Ministry of Aircraft Production and the U.S.A. Defence Plant Corporation during the war. In 1946 he went to Argentina for the B.T.H. Export Co. as manager, Latin American sales, and on returning to England was appointed deputy manager, Turbine Contracts Department, becoming manager in 1956.

Mr. R. G. A. Dimmick, B.Sc., M.I.Mech.E., M.I.E.E., commercial manager, joined B.T.H. in 1932 as a student apprentice and three years later was appointed to the Industrial Sales Department. During the war he was seconded to the research laboratory in charge of the electronics model rooms and film laboratory. In 1945 he was transferred to the Marine Department, becoming marine manager in 1947. In 1951 he was appointed manager, Industrial Motor Sales Department.

Mr. A. G. W. Cannon, manufacturing manager, was apprenticed at the B.T.H. Rugby Works and after service in the Royal Navy during the 1914-18 war he joined the company's Birmingham Works, being appointed plant and planning engineer in 1929, mechanical superintendent in 1941 and manager, Birmingham Works, in 1951.

Mr. A. G. Williamson, Assoc.M.C.T., M.I.E.E., chief engineer, joined Metropolitan-Vickers as a school apprentice in 1918 and in 1946 was appointed chief engineer, Motor Department.

Mr. W. Hall, B.Sc.Tech., divisional executive (Manchester), on completion of a college apprenticeship with M-V, became a sales engineer in the Motor Sales Department, and was appointed sales manager, Motor Department, in 1950.

Switchgear Division.—**Mr. J. R. Wilkinson,** M.I.E.E., M.Am.I.E.E., general manager, became a research engineer with Kelvin, Bottomley & Baird, Glasgow, in 1921 and in the following year joined Ferguson Pailin, Ltd. In 1924 he was made assistant sales manager and became sales manager in 1926. In 1942 he was made commercial director and became managing director in 1955. He is also a director of the Switchgear Testing Co., Ltd.

Mr. J. C. Dawson, B.Sc., A.M.I.E.E., commercial manager, who joined M-V as a probationary college apprentice, was seconded to the Admiralty as an experimental officer specialising in anti-magnetic mine devices from 1940 to 1945. He was appointed sales manager, M-V Switchgear Department, in 1956.

Mr. R. Clough, manufacturing manager, received his technical education in Australia and joined Metropolitan-Vickers as a college apprentice, becoming superintendent, Switchgear Department, in 1949 and assistant works manager (inventory control) in 1957.

Mr. C. F. Humphreys, Assoc.I.E.E., A.M.Am.I.E.E., chief engineer, joined B.T.H. at Rugby as an engineering apprentice in 1920, transferring to Willesden Engineering Department in 1924. He was appointed manager, Switchgear Engineering Department, in 1955.

Transformer Division.—**Mr. C. P. Holder,** general manager, on completing a college apprenticeship with M-V, spent three years in the Mining Section of the General Engineering Department. From 1936 to 1958 he was engaged in the design of large electrical machines, becoming successively assistant chief engineer of the Plant Department, and chief engineer of the Large Electrical Machine Department.

Mr. J. Dyson, B.Sc.(Eng.), A.M.I.E.E., commercial manager, went to M-V as a college apprentice in 1947 and, after a short period of special training, spent some months at the company's Hague office. He became sales manager, Transformer Department, in 1955.

Mr. A. Jones, manufacturing manager, started in the Steel Products Department of M-V in 1922 and was later transferred to the Transformer Department, of which he became superintendent in 1952. When the Transformer Department was transferred to Wythenshawe in 1956 he was

responsible for the planning and operation of the new factory.

Mr. L. C. Richards, B.Sc.Tech., M.I.E.E., chief engineer, joined M-V as a college apprentice in 1915 and gained experience in the Transformer Sales Department. After war service in the R.A.F., he joined the transformer engineering staff, being responsible for the design of all types of power transformers. In 1935 he took charge of the Projects and Tenders Section of the Department and in 1949 became assistant chief engineer, Transformer Department, being appointed chief engineer in 1950.

Mr. D. N. Relf, M.B.E., A.M.I.E.E., divisional executive (Rugby), served his apprenticeship at the B.T.H. Willesden Works. After the war years, in which he served as a flight lieutenant, he rejoined B.T.H. in the Switchgear Contracts Department, and was in charge of the export section. He became assistant manager of switchgear contracts in 1955 and nine months later was appointed manager of transformer contracts at Rugby.

Traction Department.—**Mr. F. Whyman,** B.Sc. Tech., M.I.E.E., M.I.Loco.E., general manager, joined Metropolitan-Vickers in 1924 as a trainee in the Traction Department, and was appointed chief engineer, Traction Projects Department, in 1944.

Mr. W. B. G. Collis, M.B.E., T.D., B.Sc., A.C.G.I., A.M.I.E.E., M.I.Loco.E., commercial manager, went to M-V as a graduate apprentice in 1928 and in 1931 joined that company's Traction Control Department, transferring to Traction Sales six years later. During the war he served with the Royal Corps of Signals as a lieutenant-colonel. He returned to Metropolitan-Vickers after the war and became assistant sales manager in charge of the M-V traction staff in London in 1953 and manager, B.T.H. Traction Department, Rugby, in 1955.

Mr. R. P. Knight, manufacturing manager, went to India as technical assistant to the M-V resident engineer in charge of electric locomotive erection for the Great Indian Peninsula Railway in 1928. In 1951 he was appointed manager of the company's Sheffield Works.

Mr. G. R. Higgs, B.Sc., M.I.E.E., M.I.Loco.E., chief engineer, joined Metropolitan-Vickers in 1920 as a college apprentice. He then had eight years' experience on the erection and commissioning of electric locomotives on overseas contracts. He was appointed assistant chief engineer, Traction Projects Department, in 1950, and chief engineer in January this year.

Mr. J. H. Cansdale, M.I.E.E., M.I.Loco.E., divisional executive (Rugby), joined B.T.H. in 1927 and after some years in the Control Gear Engineering Department, where he was engaged on traction control design, he was transferred to the Traction Department as a commercial engineer. In 1940 he was seconded to the Rugby Works staff to take charge of a radar production section, returning to the Traction Department in 1944 and being appointed deputy manager in 1946.

Mr. Maurice Tattersfield, A.C.A., F.B.I.M., has been elected to the board of the George Cohen 600 Group, Ltd., following his appointment as financial controller of the Group last year. His previous posts have included those of director and secretary of Electric Hydraulics, Warrington, and of Conveyancer Fork Trucks, Ltd.; director of the Brush Group; and managing director of the Brush Electrical Engineering Co., Ltd.

Mr. A. B. Jordan has been appointed publicity manager of Edgar Allen & Co., Ltd., in succession to **Mr. E. N. Simons.** Mr. Simons continues as editor of the "Edgar Allen News," a post he has occupied since the inception of the journal, and his services are also retained as a publicity consultant.

Mr. S. Green has been appointed commercial manager of Reliance Cords & Cables, Ltd. The following additions to outside sales staff are also announced: **Mr. K. Silveston,** South and South East; **Mr. J. Lovegrove,** Midlands; and **Mr. D. Jackson,** Lancs., Cheshire and West Riding.

Mr. J. Martin, Associate I.E.E., has been appointed sales manager of Casemakers, Ltd., a member of the Denbro Group, and will operate from the company's London office, Morley House, 26, Holborn Viaduct, London, E.C.1. Since serving an electrical apprenticeship, Mr. Martin has held appointments with Benjamin Electric, Ltd., Thorn Electrical Industries, Ltd., and Veritys, Ltd. (London manager, Lighting Division).

Mr. A. L. Ayton, F.C.I.S., has retired from his position of secretary of Keith Blackman, Ltd., and the Blackman Export Co., Ltd., after fifty years' service. He retains his seat on the board of both companies. **Mr. E. W. A. Richards,** F.C.I.S., assistant secretary, has been appointed secretary of both companies and **Mr. A. W. Milborrow** becomes chief accountant.

Mr. W. J. Pool, B.Sc., A.M.I.E.E., has retired after forty-five years' service with the British Thomson-Houston Co., Ltd. He joined the Test Department of the company at Rugby in 1914, transferring five years later to the Special Engineering (later Industrial Engineering) Department, where he was particularly concerned with the application of electric drives in paper mills and steelworks. From 1941 to 1956 he was manager of the Department, but relinquished this position in order to study problems associated with nuclear power projects on which the company was engaged.

Mr. W. J. Pool

Mr. G. B. Perry has been appointed managing director of Axia Fans, Ltd., a member of the Hall-Thermotank group of companies. He has also been appointed a director of Vent-Axia, Ltd., and will retain his seat on the board of Thermotank, Ltd., with which company he formerly held the executive posts of director, Engineering Division, and general manager, International Products Division. As the result of Mr. Perry's appointment, **Mr. R. C. Adie** has been promoted to be general manager of the Thermotank International Products Division and **Mr. H. J. Watson** will be general manager of the Engineering Division.

Mr. G. Nicholson, C.G.I.A., A.M.I.Mech.E., A.M.I.E.E., who writes in this issue on "Generating Station Maintenance," spent eleven years in the shipbuilding industry with Harland & Wolff, Ltd., before entering the electricity supply industry in 1946. He served at Fulham power station and the London Division Group II headquarters before going to Battersea for 18 months acting as assistant turbine house superintendent. Subsequently he was deputy station superintendent at Castle Donington and then at Bankside, taking up his present position as superintendent of Kincardine generating station, South of Scotland Electricity Board, in June last year.

Mr. G. Nicholson

The **Inter-Association Golf Tournament** held on 25th August at Wentworth Park, Surrey, was won by the Gauge and Tool Makers' Association, the British Association of Machine Tool Merchants being second and the Machine Tool Trades Association third. In the afternoon there was a four-ball competition which was won by Mr. J. C. Brown and Mr. A. Black for the Gauge and Tool Makers' Association. The visitors' cup was won by Mr. J. Hamilton.

Mr. A. M. Scales, who is at present in charge of the sales policy section in the head office of Atlas Lighting, Ltd., has been appointed area manager for Scotland.

Mr. W. C. Handley, Mr. D. T. Hollingsworth and **Mr. F. Waine,** directors of British Insulated Callender's Cables, Ltd., have been appointed to the board of Scottish Cables, Ltd.

Kelvinator, Ltd., is expanding its domestic sales organisation and **Mr. D. N. Spanton,** Midland regional manager, is to be transferred to the London office as assistant to Mr. D.

Welch, sales manager, domestic appliances, as from 1st October. **Mr. R. H. W. Rose,** succeeds Mr. Spanton as Midland regional manager.

Mr. H. K. Hadley, after twenty-two years' service with the British Thomson-Houston Co., Ltd., Rugby, has left to become a lecturer in the Electrical Engineering Department of Nuneaton Technical College. He took up his new post on 1st September.

At the monthly luncheon of the **Electrical Industries Club** next Tuesday, 8th September (Connaught Rooms, 12.30 for 1 p.m.), the speaker will be Mr. Kenyon W. J. Jones, vice-president of the Ronson Corporation of America. His subject will be "Chopsticks and Vodka."

Dr. R. T. Parker has been elected a director and vice-president of Aluminium Laboratories, Ltd. Dr. Parker recently took charge of the Banbury and Geneva offices of the company in succession to Mr. R. D. Hamer.

Mr. I. D. Carter has been appointed commercial manager of Preformations, Ltd. (Plessey Group). Previously he was with Murex, Ltd., and for many years had been in charge of the technical sales of pure metals and magnetic materials.

OBITUARY

Mr. L. H. A. Carr, M.Sc.Tech., M.I.E.E.—The death occurred on 27th August at Southampton of Mr. Laurence Hudson Ashdown Carr, who was associated for 35 years with the Metropolitan-Vickers Electrical Co., Ltd.; he was seventy-one. Mr. Carr joined the Lancashire Dynamo & Motor Co., Ltd., after education at Blackpool High School, Rossall School and the Manchester School of Technology. He was later for a time with the Electric & Ordnance Accessories Co. but returned to Lancashire Dynamo. In 1918 he went to J. H. Holmes & Co. as chief designer and two years later joined Metropolitan-Vickers as engineer of the large electrical machine (plant) department. He was subsequently engaged on special problems and was particularly concerned with patents and education. He retired about four years ago.

Mr. Carr was very active in I.E.E. affairs and technical education. He had been hon. secretary, hon. treasurer and chairman of the North Western Centre of the Institution and an ordinary member of the Council (1945-48), and he contributed a number of papers to the Institution proceedings. For twenty years he was a part-time lecturer at the Manchester College of Technology. He was a governor of Manchester University and a member of City and Guilds of London Institute committees.

Mr. N. M. Rust.—The death has occurred, in his sixty-eighth year, of Mr. Noël Meyer Rust, who retired in 1955 after forty-two years' service with Marconi's Wireless Telegraph Co., Ltd. As a senior radio engineer he had worked at the Marconi research laboratories at Great Baddow, Essex, for many years and was responsible for a large number of patents, the development of which made a significant contribution to the advancement of radio and television. In the late 1920s he became largely responsible for the development of the Stille system of recording on magnetised wire, a method which was extensively used by the B.B.C. for some years. He took out many patents covering, in particular, various aspects of broadcast receiver design. In the 1930s he carried out a great deal of original research into the design of broad-band feeders and aerials; among the many tangible results of this was his contribution to the aerial system of the B.B.C.'s first television station at Alexandra Palace. During the last war he did much valuable work on the design of microwave aerials and made what was probably the first of the so-called "egg-box" type of radio lens. Later he was leader of a section which carried out research into the problems associated with frequency-modulated continuous-wave radar. Mr. Rust was also closely connected with the development of an accurate method of measuring the shift of frequency which occurs when the source of radio waves is in movement with respect to the receiving point (the "Doppler effect").

Mr. John Carey-Brown, sales director of A.E.I. India Pte., Ltd., died recently in Calcutta at the age of fifty-five. Mr. Carey-Brown was a B.T.H. apprentice and was formerly manager of the B.T.H. offices at Lahore and Bombay.

Mr. L. B. Jones.—The death occurred suddenly on 23rd August, at the age of fifty-three, of Mr. Leslie Bentley Jones, joint managing director of Radio & Allied Industries, Ltd. Before joining the company in 1955 he was with Thorn Electrical Industries, Ltd.

WILLS

Mr. H. H. Smith, one of the founders and chairman of Abell & Smith's Electrical Co., Ltd., who died on 17th March last, left £35,324 gross (£35,086 net).

Mr. H. F. Wilkins, director and secretary of Abell & Smith's Electrical Co., Ltd., Worcester, left £10,492 gross (£7,353 net).

Mr. G. H. E. Vivian, A.M.I.E.E., late director of Limmer and Trinidad Lake Asphalte Co., Ltd., who died on 20th March last, left £49,341 gross (£43,735 net).

Mr. R. Ayton, late city electrical engineer, Winchester, who died on 14th May last, left £6,510 gross (£6,293 net).

Mr. S. G. Orchard, formerly for many years branch manager at Bristol of the Simplex Electric Co., Ltd., who died on 30th December last, left £3,580 gross (£2,761 net).

Mr. T. R. T. St. J. Brice, electrical engineer, who died on 25th February last, left £17,945 gross (£15,197 net).

Mr. C. L. B. White, district manager for Dorking and Epsom for the South Eastern Electricity Board, left £13,337 gross (£11,526 net).

Mr. T. W. Hibbert, formerly borough electrical engineer of Doncaster, who died on 26th November last, left £6,348 gross (£6,282 net).

Mass Spectrometer

The first production model of the MS7 mass spectrometer for measuring minute impurities in solid substances using the spark ionisation technique has been completed by the Metropolitan-Vickers Electrical Co., Ltd. In this double focusing instrument positive ions, representative of the sample composition, are produced when a high voltage spark occurs between the two electrodes of the sample material placed close together in a vacuum. After passing through electrostatic and magnetic analysers, the ions are focused according to their mass, but irrespective of their initial energy, as a series of lines on a photographic plate. The plate is used as an integrating device for impurity analysis, a series of increasing exposures being taken. A rack mechanism allows up to ten exposures to be recorded on the same plate, the exposure being determined by the total integrated charge falling on the monitor collector. Concentrations down to 0·01 p.p.m. can be estimated from the intensity of the lines on the longer exposures. Some of the materials which have been analysed with the prototype model include uranium, reactor grade graphite, germanium, selenium, silicon, copper and aluminium. Instruments for the National Physical Laboratory and the U.K.A.E.A. are among those now being manufactured.

MS7 mass spectrometer

INDUSTRIAL NEWS

Mexican Power Station Contract

The British Thomson-Houston Export Co., Ltd., now incorporated in Associated Electrical Industries Export, Ltd., recently received an order through its agent in Mexico City to construct and equip a complete steam power station for the Federal Electricity Commission. The station will be built at Juchitan in the state of Oaxaca, and is to be in commission early in 1961.

The generating plant will be manufactured at the A.E.I. Turbine-Generator Division's factories in Rugby and Glasgow. Initially, two 6,250 kW turbine-generators will be supplied, for operation with turbine stop valve steam conditions of 400 p.s.i.g., 752 deg F, and condenser vacuum of 27·5in Hg. Two 72,500 lb/hr boilers are to be supplied by International Combustion, Ltd., and the cooling towers by Film Cooling Towers, Ltd. All the miscellaneous equipment is included in the contract to complete the initial stage of the power station, which is to be constructed to accommodate a third turbo-generator and boiler plant.

The contract includes the designs for the buildings and civil engineering works; these have been prepared by Norris Consultants, Ltd., working in conjunction with the A.E.I. Turbine-Generator Division.

Trades Union Congress

The final agenda for the Trades Union Congress, which opens at Blackpool next Monday, includes eight motions on the forty-hour week. Three motions on wages are in minor key compared with previous years. Each of them rejects any form of wage restraint and supports the policy of increased wages.

There are three motions on fuel and power policy. At the head stands the motion of the National Union of Mineworkers which *inter alia* calls for the setting up of a consultative body, including representatives of the gas, coal, electricity and atomic energy industries, to secure greater operational and development co-ordination, as recommended by the Ridley Committee, within which a planned fuel policy should operate.

The Association of Scientific Workers also urges the Government "to formulate an integrated fuel policy and to undertake a long-term capital development of the mining, carbonisation, gas and electricity industries, so that the country's fuel resources will be used to the greatest possible advantage, consonant with the recognition of the right to work of those employed in those industries."

Relevant to these two motions are two paragraphs in the General Council's report which give an account of the Council's efforts to impress on the Government the need for a national fuel policy. To the Council's representations, the Minister of Power had expressed the opinion that co-ordination was already being achieved through informal consultation with Ministry committees. The General Council insisted that this was inadequate. It maintained that an annual report should be made available on this aspect of the Minister's activities. The Minister concluded, however, that the publishing of an annual report was neither easy nor appropriate. In his view there were adequate statistics and other factual information available on fuel and power matters.

The General Council is, however, to continue with its efforts to achieve effective co-ordination of the fuel and power industries.

Two motions ask for measures against radiation hazards.

The stand of the South Eastern Electricity Board at the recent Sussex County Agricultural Show

Dynamic Balancing

A booklet giving an introduction to the methods and facilities for practical dynamic balancing has recently been published by Carl Schenck Maschinenfabrik G.m.b.H., of Germany. Copies of this illustrated publication may be obtained on application by those concerned with the subject from W. & T. Avery, Ltd., Soho Foundry, Birmingham, 40.

Valve Price List

A new price list issued by the M.O. Valve Co., Ltd., at the Radio Show includes more than fifty G.E.C. radio valve types whose list prices were reduced, in some cases by over 25 per cent, at the end of June. The list, covering a total of some 200 valves, cathode ray tubes, barretters, neon indicators and photocells, includes several new types. EY86 is a half-wave e.h.t. rectifier with p.i.v. of 22 kV; LN119 is a new triode pentode; N379 is an output pentode; WD119 is a double diode vari-u pentode; and 7405A and 7503A are 17in and 21in 110 deg television tubes respectively.

Swedish Turbine Manufacturers to Amalgamate

The *Anglo-Swedish Review* reports the decision to amalgamate of the ASEA subsidiary, Svenska Turbin A.B. Ljungstrom (STAL), and A.B. de Lavals Angturbin. Growing competition in the world market is given as the reason for the amalgamation. Under the agreement STAL will take over the Laval plant and change its name to Turbin A.B. de Laval Ljungstrom. The Laval concern will remain largely as a holding company.

I.E.S. Jubilee Exhibition

In connection with the golden jubilee of the Illuminating Engineering Society an exhibition reviewing fifty years of lighting developments was held at Thoresby High School, Leeds, last week. On the Society's stand there were demonstration displays showing the principles of lighting and various applications. A light tester enabled visitors to decide for themselves how much light they needed for comfortable reading, a card being delivered bearing the value chosen. Model rooms illustrated how modern lighting could be used to the best advantage. In the manufacturing sections Continental as well as British products were on view. The exhibition was opened by the Lord Mayor of Leeds (Ald. Mrs. G. A. Stevenson), who was presented with a table standard on behalf of the Leeds Centre of the Society by Mr. A. J. Johnson.

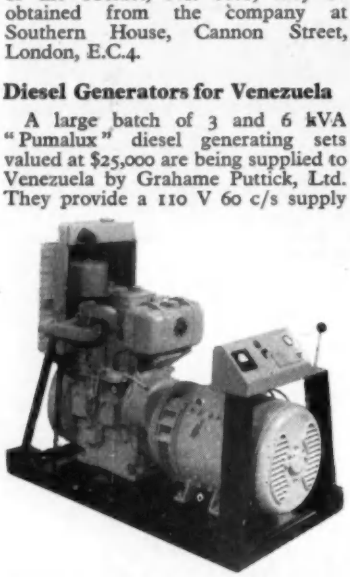
Cathodic Protection Booklet

An illustrated 12-page booklet recently published by the Sturtevant Engineering Co., Ltd., describes the use of cathodic protection against corrosion. After a brief historical note, the theory and practice of cathodic protection are discussed. Two

methods of current generation are dealt with, by the use of sacrificial anodes or a d.c. supply from a generator or rectifier, and this is followed by a survey of such engineering considerations as the current required and obtaining uniform protection. A list of the information needed to complete a preliminary design and prepare a tender is given in conclusion. Copies of the booklet, No. 6001, may be obtained from the company at Southern House, Cannon Street, London, E.C.4.

Diesel Generators for Venezuela

A large batch of 3 and 6 kVA "Pumalux" diesel generating sets valued at $25,000 are being supplied to Venezuela by Grahame Puttick, Ltd. They provide a 110 V 60 c/s supply



One of a batch of diesel alternator sets being supplied to Venezuela by Grahame Puttick, Ltd.

at 1,800 r.p.m. and employ a self-excited, self-regulating alternator incorporating 24 V battery starting and charging windings.

Educational

The prospectus for the session 1959-60 of the Sir John Cass College, Jewry Street, Aldgate, London, E.C.3, is now available.

The 1959-60 session of the Northampton College of Advanced Technology, St. John Street, London, E.C.1, commences on Monday, 28th September, and details of part-time day and evening courses are given in the prospectus obtainable from the College.

Mine Winding Equipment

By sinking new shafts at Hucknall No. 2 Colliery the National Coal Board plans, by 1961, to raise coal from this pit at the rate of 320 tons an hour from a depth of 1,908ft. The drive for the winding equipment for the new shafts, to be supplied by the A.E.I. Heavy Plant Division, will consist of a 1,400 h.p. d.c. motor fed by two Type MB6/13G1 pumpless steel-tank mercury-arc rectifiers. At first, the winder will have manual closed-loop control, but there will be provision for extension to automatic control in the future. The equipment will include a drum 18ft in diameter and 13ft wide, manufactured by Robey & Co., Ltd., of Lincoln, and the brakes will be of Robey's new high-pressure type.

Hong Kong Airport Approach Lighting

To avoid high ground near the north-west approach to the runway at Hong Kong airport, built last year on an artificial promontory extending 1½ miles into Kowloon Bay, aircraft fly a curved course leading to the final 3,000ft straight approach. The approach lighting fittings located at 400ft intervals on the curved path over a densely populated area are situated in some cases on structures erected on roofs and across streets.

Seven groups of lights mounted on dolphins in the sea spaced at 200ft and each supplied by duplicate circuits form the south-eastern approach lighting. The 8,350ft runway is equipped with lights at 200ft intervals and the taxi-track is centrally lit by green lights. The aircraft parking apron is to be illuminated by floodlights mounted on 45ft high towers. Some 700 light fittings of various types have been used in the provision of visual ground-to-air aids and more than 120 core miles of power cable and 100 core miles of control cable have been installed. All the lighting is remotely controlled from a desk in the control tower.

The consulting engineers were Messrs. Scott & Wilson, Kirkpatrick & Partners, and the electrical consultants were Messrs. Preece, Cardew & Rider, the equipment and fittings being supplied by the General Electric Co.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £180 0s 0d
COPPER, H.C. Electro	ton £236 15s 0d
Fire Refined 99·70%	ton £235 0s 0d
Fire Refined 99·50%	ton £234 0s 0d
COPPER Tubes	lb 2s 3½d
Sheet	ton £265 5s 0d
H.C. wire and strip	ton —
LEAD, English	ton £72 0s 0d
Foreign	ton £71 0s 0d
MERCURY	flask £72 0s 0d
TIN, block (English)	ton £792 10s 0d
ZINC, G.O.B. Foreign	ton £87 0s 0d
BRASS Tubes (solid drawn)	lb 1s 10½d
Wire	lb 2s 8½d
PHOSPHOR BRONZE Wire	lb 4s 1½d
PLATINUM	oz £28 10s 0d
RUBBER, No. 1 R.S.S. spot	lb 31½d—31¾d

Thermo-Electric Generators

Power for operating such d.c. equipment as battery-type radio receivers from a light source is provided in the 2 W thermo-electric generator made in the U.S.S.R. and marketed in this country by International Technical Developments, Ltd., Willow Road, Poyle Estate, Colnbrook, Bucks. The output from two thermo-electric alloy batteries, one for the filament circuit and the second for the anode and grid circuits, provides an anode supply of 11 mA at 80 to 90 V, 0·21 to 0·52 A at 1 to 1·2 V for the valve filaments and an 8 to 10 V bias. The batteries, with cooling fins and a terminal block, are mounted on the metal flue of a paraffin lamp suspended from the ceiling.

Solid State Physics

A series of ten lectures dealing with modern developments in solid state physics will be held at the Enfield Technical College, Queensway, Enfield, on successive Monday evenings at 7 p.m., beginning on 5th October. The lectures, which will be delivered by members of the Mullard Research Laboratories, cover the scope of solid state devices, their structure, fundamental properties of semi-conductors, magnetism, mechanical properties and crystal faults, resonance and such semi-conductor devices as p.n. junctions, diodes, transistors and photocells. Application forms for the lectures, which are suitable for physics graduates or others with comparable background knowledge, may be obtained from the Head of the Department of Pure and Applied Science at the College. The course fee is £1.

Irish Microwave Telephone Link

The Department of Posts and Telegraphs of the Republic of Ireland has awarded to Standard Telephones & Cables, Ltd., a contract for the supply and installation of a microwave telephone-radio link between Galway and Athlone; at Athlone the Galway trunks will be interconnected on a through super-group basis to the existing S.T.C. coaxial cable system to provide direct Galway-Dublin trunks.

The equipment to be supplied includes 7,400 Mc/s radio link equipment with antenna towers at the Galway and Athlone terminals and at the repeater station at Cappataggle, frequency multiplex equipment at the terminals, transmission test equipment, and machines for the standby power supply.

Machine Tool Control Demonstration Tour

Paris, venue of the Machine Tool Exhibition which opens on 12th September, is the first stopping place for a mobile unit demonstrating E.M.I. Electronics, Ltd., machine tool control systems. Later, main industrial centres in Belgium, Holland, Germany, Switzerland and Italy will be visited. The unit has been fitted out as a complete workshop, including a 3½-ton milling machine. Punched tape can be prepared in a programmer's office to produce any workpiece from a template to a die. In addition to continuous contouring systems, enabling

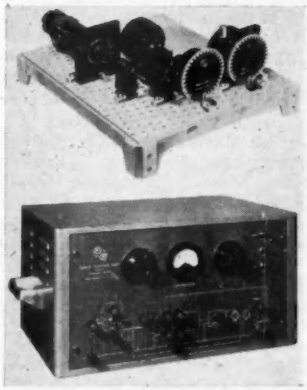
profiling to be carried out by punched tape without using a computer, E.M.I. market a range of positioning systems for linear and rotary tables. Lectures and film shows are being arranged in addition to the demonstrations, and among the other industrial aids that the unit will show is closed circuit television. Future plans for the unit include a Russian tour.

Television Equipment for Nigeria

The West Nigerian Government, having decided to establish a television service, has placed contracts with Marconi's Wireless Telegraph Co., Ltd., for the supply and installation of transmitting and studio equipment for two stations; these are at Ibadan and Abafon. A further contract awarded to Marconi's provides for the technical operation and maintenance of the stations for a preliminary period of one year, during which Nigerians will be trained to help take over the operation of the new service.

Scottish Electronic Equipment Exhibition

A wide range of electronic equipment will be shown by Servomex Controls, Ltd., and their associated company, Feedback, Ltd., at an exhibition to be held from 9th to 11th September at the Engineering Block of the Glasgow Royal College of



Control unit and servo assembly to be exhibited at Glasgow

Science and Technology. Among the equipment to be displayed are the type ESIA instructional servo system, a number of stabilised d.c. power supplies, including the latest transistorised unit, a motor controller and units for servo instruction, including a servo amplifier, an armature supply unit and an h.t. unit.

G.E.C. Export Guide

Special attention is given in the "G.E.C. Export Guide" for July to the revival of Japanese exports, the book trade, and Anglo-Soviet trade. In connection with the last the Guide says that the prospects for British exporters under the recent trade agreement are doubtful. A table shows a steep decline in British exports of electrical machinery to Russia between 1955 (£3·7 million) and 1958 (£600,000).

The elaborate charts which form the main body of the Guide indicate the prospects for 36 product groups of British exports to 34 countries. The current prospects for the third quarter of 1959 are "good" in 14 countries, "improving" in ten countries, "deteriorating" in six and "bad" in four. (This represents a further improvement compared with the last (April) issue of the Guide.) Changes in the outlook for British exports since April forecast improved opportunities in Argentina, Australia, Belgium, Denmark, Italy, the Netherlands, Pakistan, U.S.S.R. and Western Germany. Prospects are not as favourable in Iraq, Kenya, New Zealand, Norway, Spain and South Africa.

Copies of the Guide are obtainable, free of charge, from the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

"Isora" ceiling in the Solartron works

New B.S.I. Centre

The new centre of the British Standards Institution on the industrial estate at Hemel Hempstead now houses the whole of the staff of the B.S.I./C.S.A. agency. Initially the centre is being used for the work of approving electrical equipment intended for export to Canada under the arrangement by which the B.S.I. acts in this matter for the Canadian Standards Association. The address is Maylands Avenue, Hemel Hempstead (telephone: Boxmoor 6510).

Air-borne Electrical Equipment

The extensive range of specialised equipment for aircraft and guided missiles manufactured by the British Thomson - Houston Co., Ltd., Coventry, is illustrated and briefly described in a new booklet entitled "Aircraft and Guided Missile Equipment," copies of which are available on request.

Illuminating Ceiling

An illuminating ceiling has recently been installed at the Farnborough, Hants., factory of Solartron Research & Development, Ltd., in an area scheduled for a pilot plant for the manufacture of pressure transducers.

The "Isora" lightweight ceiling, which was installed below the existing fluorescent lighting fittings, was supplied by SFIM (Great Britain), Ltd., 218-221, Bedford Avenue, Slough, Bucks. The ceiling consists of panels of semi-transparent, flexible p.v.c. film stretched on a light metal framework, the panels being easily removed for cleaning and to give access to the fittings for maintenance.

Industrial Television Equipment

The first part of a large order for closed circuit television equipment to be supplied to the Hunterston nuclear power station (Scotland) has been placed with Pye, Ltd. The equipment is to be used for observation inside the reactor and for the monitoring of various other services. The contract, which includes the supply of about thirty special-purpose TV cameras of various designs, is valued at £50,000.

Fifteen closed-circuit television channels have been installed by Marconi's Wireless Telegraph Co., Ltd., in the new rolling mill of the Steel Company of Wales at Port Talbot to provide remote observation of two electrically driven buggies which travel in opposite directions on a common track and have to be brought to a halt in contact.

Telephone Answering Unit

A new automatic answering unit will shortly become available on hire to telephone subscribers. With the unit connected to a telephone, subscribers can record a 20-second message by speaking into the telephone mouthpiece, and this message is automatically played back twice to callers dialling the subscriber's number. The unit, which can be hired from the G.P.O. for £10 a quarter, measures 12 by 9in and is made in two-tone grey, to match the new G.P.O. 700 grey telephone set. The unit is manufactured by Sontranic, Ltd., and the plastic cover and base are made by K. & C. Mouldings (England), Ltd.

Floor Warming Booklet

An illustrated booklet has been published by the Simplex Electric Co., Ltd., giving details of its floor warming system evolved in conjunction with Mersey Cable Works, Ltd. After briefly outlining the advantages of

floor warming, details concerning installation are given, including planning, laying the cable and screed, and temperature control. A formula giving a rough estimate of the running cost per annum of an under-floor heating system in the conditions most likely to be met is given and the booklet concludes with a heat loss calculation sheet.

Mechanical Handling Exhibition

Space for the 1960 Mechanical Handling Exhibition to be held from 3rd to 13th May at Earls Court is rapidly being taken up by manufacturers. Exhibits will range from small hydraulic valves and hand trucks to large wagon tipplers and mobile cranes with 100ft jibs. Full details about the exhibition can be obtained from the Organiser, *Mechanical Handling*, Dorset House, Stamford Street, London, S.E.1.

Telcon Cables in Eire

An order for 75 miles of plastic trunk telephone cable was carried out for the Posts and Telegraphs Department, Eire, two years ago by the Telegraph Construction & Maintenance Co., Ltd. The cable was 7 quad/20 lb and 14 quad/20 lb aerial types with 7/·080in galvanised steel messenger wire attached. The installation was a pioneer one for cable of this type. A further order has now been placed with Telcon for another 80 miles of the same type of cable with loading coil pots, joints and erection materials. A particular feature of these cables is the exceptionally good capacitance unbalance characteristics. The pole-mounted loading coil pots are of Telcon design containing Mullard resin-potted inductance coils with Ferroxcube cores. These pots are stubless and demountable so that loading can be altered and re-routing carried out without difficulty.

Mobile Display Unit

A new mobile display van has recently been put on the road by E. J. Schofield & Co., Ltd., Manchester. The van is devoted to displaying the company's "Moonlite" fluorescent lighting units and will call upon architects, consultants, electrical contractors, etc., in Lancashire, Yorkshire, the Potteries and Cheshire.

New display van of E. J. Schofield & Co., Ltd.

Educational Models

To assist in meeting industry's need for trained technicians with experience of various specialised equipments, Evershed & Vignoles, Ltd., have made available certain of their industrial instruments in a specially adapted form to enable the operational functions and details of construction and maintenance to be studied. The instrument mechanisms are similar to those supplied for industrial applications, but are provided with transparent windows and other facilities. The three main types at present available are a model servo mechanism, a process controller and simulator of a standard type used in many of the process industries, and "Megger" test sets. Descriptive leaflets are available from the Public Relations Department of the company at Acton Lane Works, Chiswick, London, W.4.

American Circuit-Theory Symposium

The Marquette University College of Engineering, 1515, West Wisconsin Avenue, Milwaukee, 3, Wisconsin, U.S.A., has sent us the programme of the fourth Midwest Symposium on Circuit Theory to be held at Marquette University on 1st and 2nd December. Full particulars can be obtained from Mr. Stanley Koupnik, Junr., assistant director of the University's Department of Electrical Engineering.

Turkish Television Project

The Turkish Government is planning to set up a television network to cover the three major cities of Istanbul, Ankara and Izmir and is inviting preliminary inquiries from foreign firms. The project envisages a transmitter with television studios and equipment for outside broadcasts in Istanbul and Ankara, and a transmitter and outside broadcast units in Izmir. It is proposed that the network should employ the 625-line system and that the electrical system should be 380/220 V at 50 c/s. At the same time a link system between the stations is to be installed for simultaneous transmission of programmes.

The Press, Broadcasting and Tourist Department is also prepared to consider proposals for the construction and installation of a plant in Turkey for the manufacture of radio and television receivers, as well as electrical equipment, either as an independent project, or in conjunction with the television network.

Interested firms should communicate with Basin-Yayin ve Turizm Umum Müdürlügü, Ankara, Turkey, or the Press Attaché, Turkish Embassy, 43, Belgrave Square, London, S.W.1 (Sloane 6968).

Radiation Monitoring Service

A commercial radiation monitoring and tracer service for all branches of industry, medicine and scientific research is being organised by Ekco Electronics, Ltd., of Southend-on-Sea.

Trade Announcements

Merseyside Engineering (Refrigeration), Ltd., is opening new showrooms and offices at 36, West Princess Street, Glasgow, C.4 (telephone: Douglas 1440), on 10th September. The manager is Mr. J. Johnston.

Walsall Conduits, Ltd., has opened a new sales office at Chantry House, Cartergate, Grimsby, which will be managed by Mr. A. D. J. Spearpoint, under the direction of the area manager, Mr. F. N. Crabtree.

Birlec, Ltd., has established a Midland Area sales office at the company's main premises in Tyburn Road, Birmingham, 24, with Mr. H. J. Podmore as manager.

Nettle Accessories, Ltd., inform us that they have taken over the distribution of the products of Kenwell Electric, Ltd., Meanwood Works, Spotland Bridge, Rochdale, Lancs., and are acting as sole agents for the company in the United Kingdom.

Gatehill Beco, Ltd. (formerly the Gatehill Manufacturing Co., Ltd.), has opened new depots at 41, Charles Street, Cardiff (telephone: Cardiff 25639), and 36, Kingsway, Chandlers Ford, Hants. (telephone: Southampton 28392).

The trading association between **Woods of Colchester, Ltd.,** and **Thermotank, Ltd.,** under which Thermotank/Woods fans were offered to the marine industry, ceased on 31st August. This follows the merger between Thermotank and J. & E. Hall, Ltd.

The Midland regional office of **Kelvinator, Ltd.,** at Coventry, has moved to more spacious premises at 10, Park Road.

The address of the Bristol branch office of the **English Electric Co., Ltd.,** is now Equity and Law Building, 36-38, Baldwin Street, Bristol, 1. The telephone number remains the same (Bristol 27304) and the Domestic Appliance Service Depot is still at 155, Whiteladies Road, Bristol, 8.

Advertisement Correction

We regret that a typographical error occurs in the advertisement of E. N. Bray, Ltd., on page 116 (Supplement) of this issue. The first word should, of course, read "Enbray," not "Embray" as printed.

OVERSEAS ELECTRICAL TRADE

JULY RECOVERY IN EXPORTS

ELECTRICAL equipment and apparatus worth £19·9 million was exported in July. This was £2·6 million more than the seasonally low figure recorded in June, and compares with £20·4 million in July, 1958, and the monthly average of £19·4 million for the first half of this year. Exports for the seven months ended with July amounted to £136·2 million compared with a total of £130·9 million in the corresponding period of last year.

The increase in the January-July total as compared with the first seven months of 1958 was not general. As Table 1 shows, it was largely attributable to greater exports in the radio section (£24 million against £19·6 million). Elsewhere increases were balanced by decreases. Upon the whole exports of generators and motors were lower (£21·7 million against £22·9 million) in spite of a rise from £0·8 million to £2·1 million in shipments to

TABLE 1.—ELECTRICAL EXPORTS

Class	Month of July, 1959	Seven months ended 31st July, 1958	Seven months ended 31st July, 1959
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	130,931	849,575	742,157
Ditto, 10 to 65 kW	108,644	1,424,932	974,665
Ditto, 65 to 200 kW	165,760	1,357,585	1,173,565
Ditto, over 200 kW	355,304	2,884,867	2,174,738
Spark ignition engine driven	15,423	135,376	85,183
Steam turbine driven	32,178	* 539,165	545,107
Hydraulic turbine driven	—	17,542	—
Other prime mover driven	1,115	135,706	214,679
Generators, not exceeding 200 kW	103,267	906,237	688,683
Ditto, over 200 kW	34,081	739,831	661,578
Parts of generators	987,264	4,924,905	4,492,474
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ½ h.p.	205,124	1,089,835	1,136,641
Over ½ but under 1 h.p.	40,354	362,476	318,276
1 h.p. to 250 h.p.	409,870	3,335,773	3,038,169
Over 250 h.p.	207,727	835,931	1,232,933
Railway, tramway and trolley-bus motors complete and parts of all motors	260,382	1,501,833	1,820,854
Motor starting and controlling gear	300,248	1,880,789	2,354,877
	3,357,672	22,922,358	21,654,579
Converting machinery	40,505	229,705	367,877
Mercury-arc rectifiers	57,842	728,689	388,405
Transformers for lighting, heating and power (incl. coils):			
Not exceeding 7,500 kVA	485,335	4,490,921	3,357,888
Over 7,500 kVA	533,087	3,193,627	3,276,702
Switchgear and switchboards (not telegraph or telephone), up to 200 A and 660 V	341,249	2,832,863	2,451,541
Ditto, other	1,256,244	7,141,917	8,765,933
	2,714,262	18,617,722	18,608,346
Primary batteries:			
Lighting	84,606	618,861	687,481
Radio	337,115	2,063,546	2,411,014
Other	36,113	316,580	255,644
Parts (excl. carbons)	59,930	338,463	329,068
Lamps:			
Filament, exceeding 28 V	93,555	581,133	622,385
Ditto, under 28 V	23,265	200,727	200,351
Arc lamps and searchlights	28,139	128,059	126,560
Discharge lamps, fluorescent tubes, etc.	74,257	599,849	639,557
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury-arc rectifiers), photo-electric cells, stabilising and cold cathode valves, magnetrons, klystrons	47,122	185,511	291,936
All other*	483,933	2,736,939	3,541,112
Parts (excluding glass bulbs)	36,439	121,159	199,874
Radio and television transmitters	83,577	229,179	689,868
Commercial radio and radar equipment	1,567,664	8,172,723	10,823,895
Domestic radio receivers, mains	59,984	556,297	637,554
Ditto, battery	53,118	362,885	391,904
Ditto, other (incl. car)	42,540	151,141	226,813
Radiograms	15,984	208,152	176,066
Television sets	55,355	655,795	444,945
Public address equipment	83,130	675,505	661,852
Other radio and television apparatus, n.e.s.	42,882	213,984	483,979
Components and parts, n.e.s.	790,251	5,317,539	5,444,782
	3,361,979	19,586,809	24,014,580
Telegraph and telephone installations	761,158	5,199,131	5,315,942
Telephone instruments, separately consigned	83,311	1,290,280	690,754
Telegraph and telephone parts	704,517	5,319,543	5,496,870
Line apparatus for long distance communication	249,176	1,227,652	1,488,731
	1,798,162	13,036,606	12,992,297

Class	Month of July, 1959	Seven months ended 31st July, 1958	Seven months ended 31st July, 1959
	£	£	£
Cookers	43,896	371,635	263,887
Toasters	15,945	150,572	119,161
Other cooking apparatus	36,402	236,329	234,739
Parts and accessories	89,940	397,117	607,895
Space heating appliances	20,938	221,377	166,364
Water heating appliances	31,774	181,999	205,198
Other heating appliances	25,723	235,388	176,056
Parts and accessories	111,573	455,017	557,157
Irons	63,755	536,354	463,534
Arc welding equipment, a.c.	24,276	398,700	275,731
Ditto, d.c.	26,063	553,795	356,344
Resistance welding equipment	9,768	108,864	245,806
Electric furnace plant	47,582	741,539	461,617
Magnetos, ignition	13,857	108,700	93,088
Sparking plugs	206,706	1,045,765	1,124,434
Elec. appliances for aeroplanes, n.e.s.	348,772	1,985,353	2,326,667
Ditto, for motor vehicles, n.e.s.	379,002	2,697,153	2,755,806
Ditto, for cycles, n.e.s.	39,758	374,990	277,968
Signalling app. (incl. traffic signals)	254,771	987,808	1,628,890
Instruments, commercial	170,174	1,244,485	1,235,788
House service meters (including parts)	136,391	1,009,761	905,332
Electro-medical apparatus (not X-ray)	36,105	340,910	218,083
X-ray apparatus (excl. tubes and valves)	79,898	384,594	338,808
Ceiling fans, complete	60,187	754,365	639,495
Desk fans, complete and parts of desk and ceiling fans	30,949	199,098	126,559
Vacuum cleaners	119,665	885,507	954,974
Floor polishers	81,602	486,042	526,868
Food mixers	51,166	380,222	504,576
Hair clippers and dry shavers	84,651	368,572	308,366
Other portable appliances	21,857	120,159	150,169
Parts	184,819	758,356	857,011
Portable elec. tools (not saws) and parts	245,293	1,518,891	1,430,053
Cables and wires:			
Telegraph and telephone, submarine	341,078	522,504	3,460,866
Ditto, other	368,603	3,769,419	2,887,246
Cotton, silk or art. silk insulated	14,466	291,598	132,447
Enamel, glass or asbestos insulated	89,573	640,997	642,218
Paper insulated	594,819	4,896,908	4,297,427
Rubber insulated	285,377	3,244,205	2,050,306
Thermoplastic insulated	247,681	1,349,156	1,678,144
Other	148,471	1,592,290	1,133,788
	2,090,068	16,307,077	16,282,442
Accumulators for motor vehicles	142,255	1,130,179	1,027,001
Ditto, traction	19,214	151,004	152,495
Ditto, radio and other portable	33,333	435,951	206,876
Ditto, other	49,878	174,098	403,883
Parts and accessories	68,525	703,975	557,181
Electric wiring accessories	233,117	1,181,588	1,406,789
Elec. ceramic ware, etc. (incl. insulators), n.e.s.	110,175	742,576	754,946
Insulating cloth and tape	51,557	342,902	371,914
Other insulating material	156,628	703,978	1,006,028
Permanent magnets	54,903	358,411	323,092
Radio, telegraph and telephone testing equip., n.e.s.	112,952	423,214	883,571
Scientific elec. instruments (excl. telegraphic or telephonic, time recorders and time switches)	521,354	2,472,441	2,495,980
Electrical machinery, n.e.s.	25,176	511,903	203,630
Electrical apparatus and appliances, n.e.s.	1,182,069	5,964,319	7,072,210
TOTAL	19,913,517	130,852,746	136,226,324

* The figures for 1959 are not strictly comparable with those for 1958.

TABLE 2.—DISTRIBUTION OF EXPORTS (TABLE 1)

Country	Month of July 1959	Seven months ended 31st July 1958	Seven months ended 31st July 1959
	£	£	£
Gibraltar	9,223	223,419	73,434
Malta and Gozo	25,569	491,659	278,721
Cyprus	50,339	586,216	431,218
Sierra Leone	37,755	436,692	250,970
Ghana	298,866	1,095,129	1,550,426
Nigeria	505,365	2,594,038	3,332,884
Union of South Africa	1,584,384	11,730,175	11,546,836
Rhodesia and Nyasaland	932,490	3,074,602	4,662,940
Tanganyika	36,641	335,502	286,435
Kenya	184,994	965,022	1,181,656
Uganda	37,326	434,960	333,384
Mauritius	23,232	288,253	337,628
Aden	31,550	398,817	353,328
Bahrain, Qatar and Trucial States	61,705	626,270	702,160
Kuwait	233,427	1,196,656	1,392,166
India	1,720,114	11,070,355	11,322,149
Pakistan	251,663	1,634,090	1,882,189
Singapore	258,531	2,178,099	1,838,787
Federation of Malaya	176,634	1,981,895	1,672,727
Ceylon	182,143	1,074,352	1,413,093
British North Borneo	29,612	136,696	202,410
Sarawak	8,590	169,011	107,813
Hong Kong	450,651	1,982,062	2,948,221
Australia	1,637,686	11,314,357	10,091,807
New Zealand	722,354	8,006,685	5,451,236
Fiji	32,629	197,387	215,300
Canada	1,355,499	8,675,579	7,154,563
Jamaica	141,063	933,158	999,229
Barbados	29,566	183,470	244,970
Trinidad	139,394	851,148	868,577
British Guiana	77,188	499,044	489,020
Other Commonwealth countries	199,369	1,139,201	1,485,665
Irish Republic	313,243	1,951,438	2,008,317
Soviet Union	109,837	287,608	838,039
Finland	120,677	871,851	703,191
Sweden	412,052	3,194,727	3,409,264
Norway	229,460	1,481,615	1,299,120
Denmark	261,355	1,310,490	1,580,871
Poland	72,985	535,733	446,372
Western Germany	621,338	1,934,485	3,760,143
Netherlands	651,385	4,197,151	4,477,857
Belgium	224,854	1,982,913	2,178,684
France	312,629	2,534,870	1,846,246
Switzerland	122,712	1,064,253	1,125,051
Portugal	203,897	2,189,339	1,568,753
Spain	119,580	1,158,437	1,106,127
Italy	335,215	1,975,420	2,157,327
Austria	41,564	303,268	303,346
Yugoslavia	79,168	334,524	516,159
Greece	139,222	596,378	825,976
Turkey	33,838	715,404	423,962
Belgian Congo	46,898	262,416	328,187
Portuguese East Africa	35,193	165,978	164,640
Egypt	210,325	745,346	1,279,290
Libya	33,402	403,665	475,557
Morocco (excluding Tangier)	10,759	238,336	224,138
Sudan	69,484	655,044	637,946
Syria	58,820	175,850	180,551
Lebanon	58,414	365,240	361,127
Israel	74,221	661,325	791,368
Jordan	59,883	487,489	562,047
Saudi Arabia	27,107	573,045	393,074
Iraq	198,830	1,916,547	2,080,803
Iran	250,422	2,466,902	2,129,291
Burma	85,399	457,142	659,508
Thailand	56,488	928,716	629 981
Indonesia	95,125	195,747	293,417
Japan	31,993	346,421	390,206
United States of America	1,348,299	4,577,267	9,572,543
Cuba	13,205	527,183	232,084
Mexico	79,745	348,677	318,496
Colombia	29,544	245,871	220,846
Venezuela	333,374	2,653,966	2,614,906
Peru	80,189	271,539	225,037
Chile	104,258	307,502	771,763
Brazil	37,100	696,165	515,338
Uruguay	7,426	15,790	62,774
Argentine Republic	258,151	2,534,030	1,506,723
Other foreign countries	348,900	2,505,644	2,898,936
TOTAL	19,913,517	130,852,746	136,226,324

TABLE 3.—SOURCES OF ELECTRICAL IMPORTS

Country	Month of July 1959	Seven months ended 31st July 1958	Seven months ended 31st July 1959
	£	£	£
Australia	54,547	356,973	259,167
Canada	100,309	652,604	557,547
Other Commonwealth countries	195,296	714,975	929,746
Irish Republic	75,377	521,415	563,762
Sweden	92,919	706,340	764,621
Denmark	76,953	309,654	380,482
Western Germany	750,980	3,135,807	4,153,042
Netherlands	661,221	2,456,252	3,543,457
Belgium	36,254	324,299	312,691
France	188,988	782,683	1,031,777
Switzerland	158,699	759,945	1,011,689
Italy	113,510	450,037	609,198
United States	849,071	4,630,137	5,942,220
Other foreign countries	322,973	832,818	1,588,428
TOTAL	3,677,097	16,633,939	21,647,827

the United States; Canada's purchases fell from £2·5 to £2 million, but South Africa's increased from £1·9 to £2·3 million. For India, the largest importer of generators and motors, the figure rose from £2·3 to £2·5 million.

It is noteworthy that while exports of complete cooking and heating appliances were generally lower, the value of exported parts and accessories was substantially increased. For other domestic appliances (with the exception of irons and food mixers) increases were recorded.

Cable exports remained on an even keel at about £16·3 million. An outstanding feature of this section was a rise from £0·3 to £3·4 million in the United States figure; this matches up with a rise from £0·5 to £3·5 million in the value of submarine telegraph and telephone cable exported.

Table 4 sets out a number of electrical items which appear outside the electrical section of the Board of Trade returns. The outstanding items in this table are the turbines: the value of exported steam turbines rose from £4·8 to £6·7 million and of water turbines from £1·5 to £2·2 million. Substantially increased exports of locomotives are also indicated.

Electrical imports in July (Tables 3 and 5) were valued at £3·7 million as compared with £2·7 million in July, 1958, raising the seven-month total to £21·6 million, against £16·6 million. The largest suppliers were again the United States, the Netherlands and Western Germany.

TABLE 4.—OTHER ELECTRICAL AND ALLIED EXPORTS

Class	Month of July 1959	Seven months ended 31st July 1958	Seven months ended 31st July 1959
	£	£	£
Washing machines, electrically operated:			
Not exceeding 150 lb weight	304,743	2,641,061	2,047,752
150 lb to 250 lb	46,163	561,939	335,880
Parts	82,462	518,648	549,003
Electric locomotives (incl. battery types)	341,280	1,943,622	3,364,948
Diesel locomotives with electrical transmission	535,757	1,262,023	2,412,186
Welding electrodes:			
Ferrous	101,160	632,107	592,506
Non-ferrous	26,219	210,963	152,870
Electric conduit tubes and cased tubes	67,330	379,176	423,651
Electric carbons	107,153	375,686	703,825
Electric lighting fittings and lanterns (excl. arc lamps, searchlights and cycle lamps)	297,347	2,302,765	2,033,423
Electric fork-lift trucks	47,530	453,432	531,458
Steam turbines (excl. marine)	851,739	4,761,488	6,666,713
Water turbines	278,607	1,517,630	2,239,801

TABLE 5.—ELECTRICAL IMPORTS

Class	Month of July 1959	Seven months ended 31st July 1958	Seven months ended 31st July 1959
	£	£	£
Generators, incl. parts	109,771	524,850	504,623
Motors, incl. parts	150,205	637,280	864,540
Convertors; transformers; rectifiers*	72,859	220,999	632,380
Switchgear and switchboards (not telegraph and telephone)	101,501	381,364	649,228
Cathode ray tubes, complete	269,644	362,762	862,353
Other valves, complete*	212,403	1,261,972	1,626,201
Parts (excl. glass bulbs)*	103,904	270,685	462,029
Radio receiving sets, domestic or portable	44,837	82,294	166,940
Radio communication and navigational aids, complete	489,838	2,053,455	2,686,514
Other radio and TV apparatus, parts and accessories	392,408	2,364,804	2,320,087
Apparatus for telegraphy and telephony	92,475	639,909	696,034
Welding machinery	42,424	209,877	347,335
Cooking and heating apparatus	117,586	874,772	958,260
Magnetos, ignition, and electric appliances for aeroplanes, motor vehicles and cycles	210,326	1,457,838	1,184,341
Electro-medical apparatus (incl. X-ray apparatus)	68,349	450,013	557,634
Portable mechanical appliances, electrically operated, complete	122,015	583,134	753,717
Parts	61,932	429,592	383,045
Scientific electrical instruments (excl. telegraphic and telephonic)	146,394	1,072,406	982,741
Other machinery, apparatus and appliances	868,226	2,735,933	5,009,825
TOTAL	3,677,097	16,633,939	21,647,827

* The figures for 1959 are not completely comparable with those for 1958.

Generating Station Maintenance

THE ORGANISATION OF AN INTEGRATED SYSTEM

By G. NICHOLSON, C.G.I.A., A.M.I.Mech.E., A.M.I.E.E.*

Plant availability, and hence planned preventive maintenance, has assumed greater importance as the size of turbo-alternator/boiler units has increased. Methods of controlling a maintenance system and the keeping of cost and plant records are discussed, but the author contends that the first essential is a sound overall station organisation

In all forms of business activity various arrangements of "line" and "staff" departmental organisation exist. It is usual to distinguish one main aspect of business, for example, the production shop in a manufacturing concern, as the "line" and all other departments, including maintenance, as "staff" or functional.

In generating station organisations, there are similar "line" and "staff" arrangements but it is usual to treat maintenance as a "line" activity closely associated with the plant operation. In fact, by "power station operation" we often imply the actual operation of the plant and its maintenance, as from a practical point of view the two are closely related and interdependent.

The advent of the larger and more efficient generating unit has given increasing importance to the station engineer's stock phrase of "plant availability" with all that it implies. The term has always been somewhat revered and it became particularly so after the last war when there were serious generating plant shortages. Today, this shade of added importance due to shortage has been replaced in the modern stations by the possible effects of "outage" of large units and also by the costs incurred thereby. These will be of the order of £4,000 per day in summer and £5,000 per day in winter for a 100 MW unit, owing to the need to run less efficient plant to cover the loss.

Plant manufacturers have achieved good results by producing boilers and turbines of high capacity, efficiency and availability. It is, however, principally due to improvements in availability that such advanced designs have been possible and acceptable. In turn, station maintenance departments have had to face new requirements and their success can be measured by the degree of station availability.

A well-organised maintenance department is necessary in any station if best operating results are to be obtained. The means of achieving this are certainly not new but are as fundamental as operating procedures themselves. It is only the forms of organisation which differ according to personal preference, size of station, type of plant and particular problems involved. It is, therefore, not professed that new techniques of maintenance organisation are being propounded for these are only the aids towards sound organisation, which to a large extent must stem from the attitude of the individuals concerned.

Forms of Maintenance

Maintenance work takes one of three forms:—(1) Planned work on a large scale; for example, prearranged overhauls and statutory inspections. (2) Breakdown work which may be due to lack of maintenance, poor operation, faulty installation, or just fortuitous failure. (3) Routine preventive maintenance designed to reduce or eliminate sections of (1) and (2) above.

The carrying out of work according to (1) and (3) above, although (2) has also to be catered for, are the aims of any planned maintenance system, the basic elements of which may be stated to be:—(a) A systematic method of planning maintenance work in advance. (b) Organising work on a daily basis and controlling it to save manpower. (c) Providing facilities for carrying out work of a breakdown nature. (d) Keeping essential records that tell a story. (e) Controlling maintenance stores so as to have adequate but not excessive supplies, thus avoiding tying up capital.

The Planning Function

Maintenance planning is necessary to achieve maximum effectiveness, ensuring high plant availability and low costs; job planning is equally important so that each man can be kept fully occupied and waste of manpower avoided. Work must thus be planned systematically, particularly in the larger station where over 10,000 separate jobs may be carried out each year. In fact, in stations over about 200 MW capacity, the function of planning can become full-time, but wherever possible it is considered desirable that it remains within the executive line of the maintenance department.

The function of planning involves the arrangements for carrying out all schemes of work on a logical and systematic basis. It involves the preparation of work schedules, allocation of men, provision of services and equipment to enable jobs to be carried out expeditiously. There has to be forward ordering and progressing of spares and materials to ensure that they are available when required. Minimum stocks have to be maintained at practical levels and varied, up or down, to suit any changing conditions on the plant.

It is necessary to segregate all work outstanding according to the following divisions:—(1) Work in progress. (2) Work to follow. (3) Work awaiting outage of plant. (4) Work awaiting labour. (5) Work awaiting materials. The respective sections can then be controlled and progressed, and delays kept to the minimum. The method of reporting and scheduling all items of work, be it routine maintenance or of a breakdown nature, can be by use of job cards. In the former case, where necessary, these are initiated by the maintenance engineers, and in the case of a breakdown they are submitted by the operating staff.

For carrying out the routine work, such as p.f. mill

* Station Superintendent, Kincardine Generating Station.

Card No.	Date 19	
Plant		
Nature of Defect/Modification/Construction		
Any Other Remarks (Urgency etc.)		
When Plant Available		
Permit Required Yes/No	Isolation	
		Signed

Card No.	Craftsman	P.T.W. Application No.
Plant		P.T.W. Attached/with C/E's/Not Wanted
Work to be Executed		
Test Results Required		
		Signed

Card No.	Cost Code No.	P.T.W. Application No.	
Plant		P.T.W. Attached/with C/E's/Not Wanted	
Stores Order No.	ITEM	Date of Order	Delivered
Additional Stores			
Special Equipment			
Drawings Reqd.			
		Signed	

Summary of Work Carried Out			
Tested By			
Any Other Remarks			
Date Commenced			
Date Completed		Cost Code No.	
Man Hr (Skilled)	(Unskilled)	Signed	(Craftsman)

The four components of a typical job card

inspections and adjustments, etc., and for the statutory and periodical examination of plant and equipment, it is essential to use a simple visual aid system to indicate clearly when such examinations become due.

Typical Job Card System

Job cards must be submitted for all work to be carried out and routed through the maintenance office. The detail of the card can be varied to suit the system adopted but a typical type is reproduced. The information to be given on the card by the party initiating it is self-explanatory but it is obviously important to give full details of the defect or work to be done, whether a "permit-to-work" is required, details of isolation, availability of plant, and degree of urgency. A flimsy copy of the card is retained for reference until the work has been carried out.

Each item of work should be assessed for labour, materials, equipment, and availability of plant, and if all are satisfactory then the card is held in readiness for the work to be attended to as quickly as possible. Materials and equipment should be arranged beforehand so the craftsman's time is not wasted in seeking these items before starting the job. If any necessary service is not available then the card is posted to the appropriate section for attention later.

Whether or not the card is issued immediately, details are first assessed and entered on the card of any special tools, lifting tackle, test equipment, etc., that may be required and the appropriate cost code number quoted, the latter being required by the craftsman for entering on his time-clock card. For work awaiting materials, these items will be cleared as the information of delivery is received from the stores in the form of a daily "goods received" statement for materials, items of plant and spares.

As cards are drawn by the foremen in charge of work, stores requisitions will be attached for known materials required, drawings and the "permit-to-work," the last-named having been initiated by an application form to the operating staff. Upon completion of the work, the craftsman is required to give details on the card of work carried out, time spent and major parts renewed. The foreman should carry out an inspection of the job, see that all material and equipment are removed, cancel any permits and return the card to the maintenance office, the information from the card being entered into the history file for the section of plant. The operating staff should be notified of all job cards being cleared.

Maintenance Office

The maintenance office is mainly concerned with planning, co-ordination, control of work, costs and plant spares. In planning, routine preventive maintenance schedules have to be drawn up 12 months ahead but it is essential to see that this work is appropriate to the plant and is not in any way unnecessary or wasteful. For the larger items, job specifications should be used, based upon experience. These comprise standard written instructions on the best methods of carrying out the work and the equipment required and will be used each time the particular job is carried out. Economies can result from this practice but it is necessary to review procedures from time to time.

Major overhaul schedules have likewise to be prepared and materials, equipment and spares assessed and ordered, where necessary, well in advance. Times for carrying out sections of work have to be determined and reduced wherever possible by skilful deployment and use of man-power. The possibility of congestion due to overlapping

of different work on the same plant or area must be foreseen and avoided. As much pre-outage work as possible has to be carried out, including erection of scaffolding, removal of lagging and casings and early provision on the job of tools, jigs and spares. In the day-to-day planning of work, it is important that the sequence of jobs be controlled and attention given to degrees of urgency. Provisions have to be allowed in all schemes of work for certain craftsmen to be made readily available to deal with emergency breakdowns, including those arising outside of normal office hours.

Co-ordination between the electrical and mechanical maintenance departments and other departments is essential at all times. If work of a mechanical nature is being carried out, assistance of an electrical kind may be necessary. In addition, one department may wish to take advantage of an outage arranged by the other to carry out certain routine work. Some routine preventive maintenance jobs can be combined on the schedules and co-operation in arranging outages and overhaul programmes is essential.

In the control of work the use of a "job card rack" is a definite aid. It consists essentially of the following main sections into which cards are posted but remain visible:—(1) Work in progress. (2) Work to follow. (3) Work awaiting outage of plant or availability of labour. Section (3) is suitably divided and segregated into the various sections of plant. Other subsidiary sections are provided in the rack to receive new cards before their allocation, for cards awaiting materials and for completed cards awaiting the extraction of information for the records.

Copies of the "work-in-progress" cards are filed under each craftsman's name, the other copies being in the possession of the craftsmen and a "flimsy" in the possession of the initiating party. The "work-to-follow" cards are likewise filed under the respective craftsmen's names; this is to ensure that each man has a number of jobs awaiting him and that time is not being wasted after completing one item of work and waiting for the allocation of another. As cards are transferred forward from this section other cards are moved up from the other sections, having regard to priority and volume of work in hand by each man.

The job card rack as a visual aid is most useful for it gives at a glance the amount of work outstanding in the department; it enables orders for materials to be progressed; it ensures that each craftsman has a job to start as soon as his current one is finished; that each craftsman can be quickly located and the position of each job in the scheme can be readily ascertained.

In the effective deployment of men there are relative advantages in specialisation and non-specialisation. In the former case more skilful and speedy working can be achieved due to the craftsmen being thoroughly familiar with the requirements of the job; whereas non-specialisation can be said to give greater cover and flexibility resulting from the fact that any man can be put on any job. In practice, it is considered better to try and get the best of both by working to a system of specialisation, e.g. craftsmen for turbine plant, boiler plant, etc.; but at the same time sending these men to other closely allied work at times when their own type of work is short, or in times of emergency. In addition, a system of rotational duty is useful.

It is desirable that the respective maintenance departments should have delegated responsibility for their proportions of works cost, first budgeting and then endeavouring to keep to the budget. By using their estimate for each separate account they should be enabled to compare these with the actual monthly costs arising, preferably by graphical means.

The station fuel cost per kWh sent out is increased by the fuel handling charges, which includes maintenance costs on this section of plant. The biggest item arising here in the case of the pulverised fuel fired stations is the pulverising costs, which should be used for comparison and control purposes as maintenance cost expressed in pence per ton of coal milled. In addition, the actual monthly and annual milling costs should be collated and expressed as a percentage of the total handling costs. Comparison with other similar stations is a useful control medium using the above figures and also the three broad divisions of total R and M (repair and maintenance) costs; viz.:—R and M handling, R and M boilers, and other R and M. These figures are also useful for internal comparison of one period with another, used either as straight R and M costs or £/MW or pence/kWh.

APPLICATION FOR PERMIT TO WORK		
Plant		
Work to be Executed		
Isolation Required		
Job Card No.		
Date of Application	19	
Time of Application	Hrs	
Date Permit is Required	19	
Time Permit is Required	Hrs	
Dept. Requesting Permit		
		Signed

With regard to the control of stocks of plant spares, the optimum level is largely determined by foresight, experience and sound common sense, following the initial recommendations made by the plant manufacturers. Ratios have been used of capital value and of stocks related to MW capacity of the station but this is a very inexact method. The best method is surely to determine the maximum and minimum level for all items of stock and for the stores clerk to be given authority to replace items within the specified limits. From time to time the maintenance engineer should appraise his stock position and, in the light of experience and plant performance, vary the maximum and minimum levels, up or down, accordingly.

Records Required

A comprehensive and up-to-date record system for the maintenance office is most essential. Generally, its scope should be as follows:—

(1) Plant history.—This should consist of a detailed report of all work carried out, details of condition of plant, etc., for each overhaul on every boiler and turbine. Basic data such as precommissioning alignments, settings, etc., will also be included. The reports will be most useful for reference purposes and in planning subsequent overhauls.

(2) A card index or similar system should be maintained for recording the information from completed job cards of work carried out daily, time taken, etc. Thus, there will be a complete record, for each section of plant, of defects and performance which can be used for purposes of control, planning, method study and statistics.

(3) All the necessary plant drawings should be filed for

reference purposes, into the appropriate plant sections, and suitably indexed.

(4) A full collection of makers' catalogues of spares, equipment, tools, etc., should be kept available for ready reference.

(5) Other records to be kept include plant technical data; types of spares; plant running hours; test and insurance reports; details of stocks of main spares; performance schedules; departmental cost records; and routine maintenance and main overhaul programmes.

The maintenance office is responsible for the preparation of certain reports that provide the management with essential information on the department's operations. These normally take the form of weekly and monthly reports on the progress of major jobs, such as overhauls and certain new installations and any special jobs, including points of difficulty, problem or interest and details of inspections.

Conclusions

The systems of organisation procedures are incidental to the importance which attitude of mind plays in establishing and maintaining sound forms of organisation. In this context good two-way communication, formal and informal, is essential at all times throughout the management team. Proper delegation of responsibility with appropriate authority to act must apply but full use should be made of "accountability" and the other means of control.

Acknowledgment is due to the chief engineer of the South of Scotland Electricity Board, for permission to publish this article.

Buried Transformers

THE first of a new type of buried distribution transformer manufactured by the Hackbridge & Hewittic Electric Co., Ltd., in which an associated cooling unit above ground permits larger capacity equipment to be installed in this manner and enables a standard oil-immersed core and coil assembly to be used, was recently installed in the Hendon District of the Eastern Electricity Board. The 500 kVA transformer has a voltage ratio of 11,000/433, and tappings are provided at plus and minus 2½ and 5 per cent taken to a link board, access to which is gained through a hand-hole in the lid.

Fitting the radiator enclosure on the 500 kVA Hackbridge buried transformer

The equipment consists of the transformer assembly in a tank, fitted with horizontal incoming and outgoing cable boxes, and a cooling radiator including a built-in conservator enclosed in a sheet steel case. The transformer is buried directly in the ground on a concrete raft, the radiator being mounted on a frame mounted on the transformer tank with the bottom of the case at ground level. The outlet pipe from the radiator incorporates a standpipe, enabling the oil to be circulated or the tank emptied. The radiator is a sectional type of conventional design and its case is arranged with cooling louvres on both sides to give adequate ventilation. A lockable inspection door is included giving access to the oil level gauge and thermometer on the conservator cover.

Larger or smaller capacity units can be supplied. The height of the radiator and its casing, 4ft 6in, is constant, its length being adjusted according to the transformer rating. If desired, the transformer can be arranged in a shallow brick-lined cavity so that cable boxes and adjusting tappings can be conveniently reached. If necessitated by site conditions, the radiator can be mounted separately and off-set from the transformer within certain limits.

Australian News

THE Power Switchgear Committee of the Standards Association of Australia has appointed a special panel to deal with high voltage testing and related matters. Subjects so far discussed include standard high voltage testing techniques, measurement of voltage with sphere gaps, impulse levels, and the possibility of publishing a brochure on the preparation and submission of equipment for high voltage testing.

A five-man team of Japanese consulting engineers, led by Mr. Tasuke Kumakura, has been visiting the Snowy Mountains Scheme, and has consulted with the New South Wales, the Victorian and the Tasmanian Electricity Commissions with a view to quoting for large electrical projects.

During the financial year ended 30th June, 1958, 19,797 million kWh was generated in Australia, 15,600 million in Government stations, 2,375 million in local authority stations, 1,065 million in company-owned stations and 757 million in other works. The number of people employed in the industry was 12,833 and the year's salary and wage bill amounted to £13·5 million, an average of £1,053 per employee.

Power expansion plans for Queensland, to cost about £200 million over a period of 10 years, are expected to be announced early in the coming financial year. Investigation of the State's power requirements is being carried out by Messrs. Merz & McLellan.

The Rocky Valley dam, main storage for the Victorian State Electricity Commission's Kiewa hydro-electric scheme, has been finished. Water from this dam will be taken more than four miles by tunnel and pipeline to drive the generators of the 96 MW power station now being built 250ft underground. The first set is expected to be operating by next winter. The Commission plans to build its Hazlewood power station in progressive stages by 1971. This station will have a generating capacity of 1,200 MW (six 200 MW sets) and will be more than three times as large as the existing Yallourn station. It will cost, with the necessary development of the Morwell open cut, about £100 million.

Electrical Industries' Golf Championship

THE finals of the Electrical Industries National Golf Championship will be played on 21st September at Moortown Golf Course, Leeds. The annual dinner will be held at the Queens Hotel, City Square, Leeds, in the evening (7.30 for 8.30 p.m.), and applications for tickets (32s 6d each) should be made to Mr. J. Nicholson, c/o 1, York Place, Leeds, 1.

GENERATION and DEVELOPMENT

United Kingdom Electricity Supply

Detailed information on the fuel and power industries in the United Kingdom is given in the "Ministry of Power Statistical Digest 1958" (H.M. Stationery Office, £1 17s 6d). Of the 123 tables, 18 relate to electricity supply, covering generation, output, plant installed, fuel used, thermal efficiency, works costs, capital expenditure, energy sales and appliance sales. In a number of cases the latest figures are those for 1957.

Returns published at the beginning of this year (*Electrical Review*, 23rd January, page 173) showed that 98,500 million kWh was generated (92,687 million kWh sent out) by public supply authorities in Great Britain. In addition, details were included of generation by certain industries, amounting to 10,423 million kWh. The "Digest" now gives the total kWh sent out in the United Kingdom, including Northern Ireland, as 107,015 million kWh, compared with 99,967 million kWh in 1957, an increase of 7 per cent (see Table 1). Excluding Northern Ireland, sales in 1958 totalled 83,869 million kWh, against 77,218 million kWh in 1957 (see Table 2). The largest increase was in domestic supplies, which rose by 3,123 million kWh (13·3 per cent) to 26,548 million kWh. Sales for all purposes, except traction, averaged 4,893 kWh per consumer last year, compared with 4,594 kWh in 1957 and, per head of the population, 1,668 kWh (against 1,543 kWh).

The fuel industries and railway and transport authorities are not included in the analysis of industrial generation published each month. The relevant table in the "Digest," however, gives the following figures for 1957 (million kWh):—Coal mining, 1,221; gas supply, 141; mineral oil refining, 254; and railway and transport electricity undertakings, 1,208; total, 2,824.

ELECTRICITY OUTPUT IN THE U.K. (INCLUDING NORTHERN IRELAND)

	1957	1958
	Million kWh	
Public supply:		
Thermal	84,566	91,826
Hydro	2,092	2,102
Total	86,658	93,928
Industrial production*:		
Thermal	12,249	12,186
Hydro	653	593
Nuclear	409	305
Total	13,311	13,088
Transfers from industrial producers to public supply	501	753
Exported (from Northern Ireland to Republic)	2	1
Total available for consumption	99,967	107,015

* Partly estimated.

ANALYSIS OF ELECTRICITY SALES* IN GREAT BRITAIN (EXCLUDING NORTHERN IRELAND)

	1957	1958
	Million kWh	Million kWh
Domestic	23,425	26,548
Farms	1,425	1,679
Commercial premises†	10,733	12,057
Industrial	39,348	41,241
Railways	1,215	1,233
Trams and trolley-buses	330	318
Public lighting	742	793
All consumers	77,218	83,869
Sales per consumer:	kWh	kWh
Domestic	1,617	1,793
Farms	6,396	7,114
Commercial premises†	6,880	7,620
Industrial	201,786	212,215
All consumers (excl. traction)	4,594	4,893
Average selling price per kWh:	d	d
Domestic	1·624	1·699
Farms	1·556	1·600
Commercial premises†	2·017	2·061
Industrial	1·309	1·335
Railways	1·224	1·238
Trams and trolley-buses	1·415	1·423
Public lighting	1·545	1·624
All consumers	1·509	1·562

* In addition, direct sales were made by railway and transport authorities from own generation. In 1957 these amounted to 54 million and 134 million kWh to commercial and industrial premises respectively as well as 656 million kWh used for traction.

† Including sales to combined domestic and commercial premises, public buildings and H.M. Forces.

Padiham "B" Contract

M. J. Gleeson (Contractors), Ltd., North Cheam, Surrey, has been awarded a £1½ million contract for the construction of the superstructure to Padiham "B" power station, near Burnley, Lancs. The scheme, to be carried out for the Central Electricity Generating Board, Northern Project Group, includes the construction of a turbine house, boiler house and ancillary structures. The engineering consultants are Messrs. C. S. Alott & Son, and Messrs. Cruickshank & Seward are the architects.

New Plant Commissioned

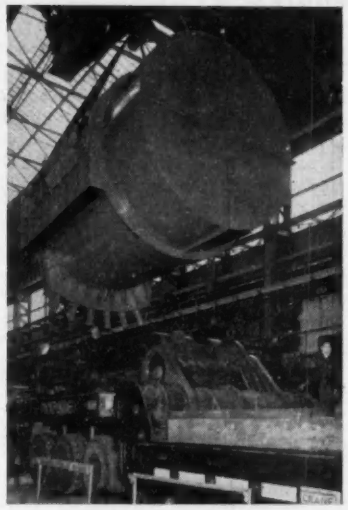
During July the Central Electricity Generating Board commissioned a 100 MW English Electric turbo-alternator and an 830 klb/hr International Combustion boiler at Willington "A" power station.

Belfast Concessions

In view of the net surplus of £194,548 on the past year's working of the Belfast Electricity Department, the general manager (Mr. R. P. Watson) has recommended that the prompt payment discount shall be increased from 2½ to 5 per cent. The estimated cost of this concession in a full year is about £100,000. It is also proposed to reduce the coal charge by an amount equivalent to £25,000 a year.

Midlands Rural Electrification

The Midlands Electricity Board is to spend more than £500,000 on the development of electricity supplies in rural parts of Shropshire and Herefordshire during the current financial year and it is hoped in the course of the programme to provide supplies to upwards of 600 more farms in the two counties.



Stator for a 120 MW turbo-alternator being loaded at the Witton Engineering Works of the General Electric Co., Ltd. Six sets of this rating are being supplied by the company for the C.E.G.B. power station at Northfleet, Kent

OVERSEAS

Tenders for Ceylon Power Plant

Our Colombo correspondent reports that a dispute has arisen over the selection of tenders for a stand-by thermal power plant in Ceylon. Tenders were invited last year and several firms, both British and Continental, sent in quotations for the four separate parts of the contract. The Government referred them to a British firm of consultants who suggested four separate firms, three of which were British. Mr. Prinz Solms, First Secretary of the German Embassy in Ceylon, asked that the tenders should be reconsidered, contending that the selection should be made primarily on the basis of the lowest figure. The Tender Board is expected to adjudicate in this dispute.

Toronto Space Heating Campaign

In their report for 1958 the Toronto Electric Commissioners declare: "Unquestionably, the fastest growing development in the age of electrical living is that of space heating. Interest in this subject has, in recent years, far exceeded most expectations." A vigorous promotional campaign is being undertaken.

DOMESTIC ELECTRICAL EQUIPMENT

LOW-TEMPERATURE HEATERS

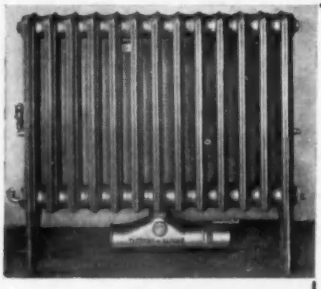
ELECTRIC space heating equipment is generally recognised as being in two distinct forms—radiant heating and convection heating. Radiant heaters, or electric fires, were dealt with in our last survey and we now turn to convection or low-temperature heating. From the safety aspect, the low-temperature form of heating is ideal; not only are the heating elements completely enclosed but the actual surface temperature of the outside casing or cabinet is never sufficient to cause burning. There are many variants of this form of heating including convectors, water- and oil-filled radiators, panel heaters, fan heaters, etc., all of which have their own special advantages to suit a particular installation or home heating problem. For the heating of halls or passages, or providing background heating in living rooms, etc., portable convectors are widely used, while the oil-filled electric radiator, another attractive form of heating, enables the user to enjoy the advantages of central heating without the addition of installation and plumbing costs.

Fan heaters, as their name implies, serve a two-fold purpose. Designed for the smaller room, such as the kitchen or nursery, they rapidly increase the room temperature while, during the warmer months, they can also be used to provide cool air. The average loading of this form of heater is in the region of 2 kW and most are provided with a three-speed fan.

A fan heater is included among the several new models which Morphy-Richards have introduced this season. From Belling & Co. comes a new 1½ kW convector, the "Zenith," while Alfred Graham & Co., an A.E.I. subsidiary, have introduced the "Penguin" convector in 1 and 2 kW sizes.

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
A.E.I.-HOTPOINT, LTD., 33, Grosvenor Place, London, S.W.1.	6020/1	Portable	24×18×7⅞	2 kW	Switched	Sheet metal	Bronze or silver grey hammer finish	£7 11 9	£1 7 9
	6025/6	Portable	24×18×7⅞	2 kW	Thermostatic	Sheet metal	Bronze or silver grey hammer finish	£8 7 10	£1 10 8
ALLIED IRON-FOUNDERS, LTD., 28, Brook Street, London, W.1.	"Falco" KE/20/2	Portable	28×19×10	2 kW	Switched (a) or thermostatic (b)	Pressed steel	Gold, blue/gold or grey/blue	£7 7 0 (a) or £7 17 0 (b)	£1 6 11 (a) or £1 8 8 (b)
ARGOSY ENGINEERING, LTD., Hertford Road, Barking, Essex.	"Argosy"	Portable	24×20×8½	2 kW	Thermostatic	Steel	Old gold stoved enamel	£8 0 6	£1 9 0
	"Jay"	Portable (a) or wall fixing (b)	9×36×4 (a) 6½×36×3½ (b)	900 W	Switched	Steel	Old gold stoved enamel	£4 18 0	£0 18 0
F. W. BAKER & SONS (SALES), LTD., Fontwell Avenue, Eastergate, Chichester, Sussex.	"Mayhurst"	Portable fan heater	11×11 dia.	2½ kW	3-heat, thermostatic	Steel	Hammer bronze, red, yellow or blue	£11 19 9	£2 3 9
	"Elfin"	Portable fan heater	6½×11 dia.	1½ kW	Hot or cold switch	Steel	Guardsman red or pebble	£6 10 0	£1 3 8
	"Universal"	Wall mounting fan heater	6½×11 dia.	2 kW	Hot or cold switch	Steel	Guardsman red or pebble	£6 10 0	£1 3 8
BELLING & CO., LTD., Bridge Works, Enfield, Middx.	"Champion" 91A	Portable	22½×9½ dia.	750 W	2-heat	Steel and cast iron	Silver bronze	£3 12 6	£0 13 4
	"Champion" 92A	Portable	23½×10½ dia.	1·5 kW	2-heat	Steel and cast iron	Silver bronze	£4 5 0	£0 15 7
	"Champion" 83A	Portable	24½×13 dia.	2½ kW	3-heat	Steel and cast iron	Silver bronze	£6 4 0	£1 2 9
	"Zephyr" 851	Portable	19½×22½×6½	1 kW	3-heat (thermostat extra)	Steel	Old gold and bronze	£9 10 0	£1 14 10
	"Zephyr" 852	Portable	22½×33×6½	2 kW	3-heat (thermostat extra)	Steel	Old gold and bronze	£13 5 0	£2 8 7
	"Zephyr" 853	Portable	22½×45×6½	3 kW	3-heat (thermostat extra)	Steel	Old gold and bronze	£17 10 0	£3 4 2
	"Warm Air Circulator" 85	Wall fixing	23½×6×5	750 W	2-heat	Steel	Choice of three colours	£4 15 0	£0 17 5
	"Warm Air Circulator" 86	Wall fixing	23½×12×5	1·5 kW	2-heat	Steel	Choice of three colours	£6 2 6	£1 2 6

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
BELLING & CO., LTD., Bridge Works, Enfield, Middx. (continued)	"Warm Air Circulator" 87	Corner fixing	23½ × 9 × 6½	750 W	2-heat	Steel	Choice of three colours	£4 2 6	£0 15 2
	"Handy Heater" 952 (a), 952B (b)	Floor mounting	12 (a), 22½ (b), × 4½ dia.	250 W (a), 500 W (b)	—	Steel and cast iron	Bronze	£1 15 0 (a) £3 0 0 (b)	£0 6 5 (a) £0 11 0 (b)
	"Zephyr" 851F	Wall fixing	21 × 19½ × 5½	1 kW	3-heat (thermostat extra)	Steel	Old gold and bronze	£9 10 0	£1 14 10
	"Zephyr" 852F	Wall fixing	21 × 33 × 5½	2 kW	3-heat (thermostat extra)	Steel	Old gold and bronze	£13 5 0	£2 8 7
	"Zephyr" 853F	Wall fixing	21 × 45 × 5½	3 kW	3-heat (thermostat extra)	Steel	Old gold and bronze	£17 10 0	£3 4 2
	"Air Warmer" 961A	Wall or floor mounting	3¾ × 8 × 13¾	500 W	—	Cast iron	Black vitreous enamel	£2 5 0	£0 8 3
	"Air Warmer" 962A	Wall or floor mounting	3¾ × 8 × 18	1 kW	—	Cast iron	Black vitreous enamel	£2 17 6	£0 10 5
	"Zenith" 95	Portable	19½ × 28 × 7	1½ kW	3-heat	Steel	Green or silver bronze	£5 18 10	£1 1 10
BENHAM & SONS, LTD., 66, Wigmore Street, London, W.1.	"Electro-Vapour" 4 PR	Semi-portable	21½ × 22½ × 5¾	1 kW	Single or 3-heat switch	Cast iron	Sprayed aluminium or bronze paint	£21 0 0	£3 17 0
	"Electro-Vapour" 6 PR	Semi-portable	27½ × 27 × 5¾	1½ kW	Single or 3-heat switch	Cast iron	Sprayed aluminium or bronze paint	£26 0 0	£4 15 4
	"Electro-Vapour" 7 PR	Semi-portable	27½ × 31½ × 5¾	2 kW	Single or 3-heat switch	Cast iron	Sprayed aluminium or bronze paint	£28 0 0	£5 2 9
	"Electro-Vapour" 9 PS	Semi-portable	27½ × 33¾ × 8½	3 kW	Single or 3-heat switch	Cast iron	Sprayed aluminium or bronze paint	£36 17 6	£6 15 3



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1. *Benham "Electro-Vapour" radiator*
2. *Argosy 2 kW convector*
3. *Allied Ironfounders "Falco" model KE/20/2 convector*
4. *A.E.I.-Hotpoint model 6025/6 convector*
5. *P. W. Baker "Mayhurst" portable fan heater*
6. *Belling "Zephyr" range of convectors*

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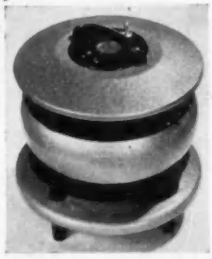

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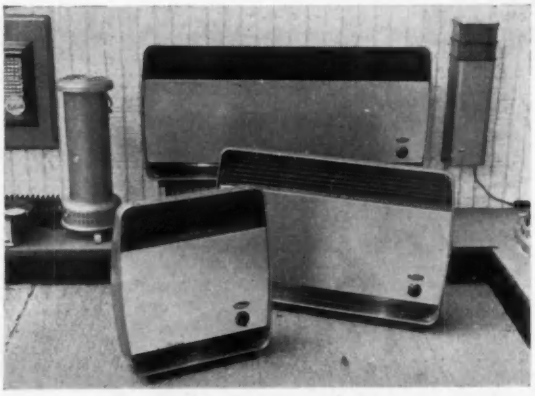

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Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
BERRY'S ELECTRIC MAGICOAL, LTD., Touchbutton House, Newman Street, London, W.1.	"Solano"	Fan heater	11½×15⅝×9½	2 kW	2-heat (a) or time switch (b)	Steel	Cream with warm silver top	£9 14 10 (a) £12 5 7 (b)	£1 15 8 (a) £2 4 11 (b)
BESCOL (ELECTRIC), LTD., 118, Parkfield Road, Saltley, Birmingham, 8.	"Contemporary" 270 and 272	Portable	18⅛×22×8	2 kW	Switch (270) or thermostat (272)	Steel	Two shades of beige	£5 17 6 (270) £6 12 6 (272)	£1 1 2 (270) £1 3 11 (272)
	"Midget" 270 MS and 270 M	Portable	14⅛×12×8	1 kW	Switched (a) or unswitched (b)	Steel	Two shades of beige	£4 15 0 (a) £4 0 0 (b)	£0 17 2 (a) £0 14 5 (b)
BYLOCK ELECTRIC, LTD., South Street, Enfield, Middx.	"Heatmaster"	Fan heater	14½×12×5	2 kW	3-temperature rotary switch, 2 fan speeds	Steel	Primrose yellow, black handle	£6 12 0	£1 3 0
CENTURY CONVECTORS, LTD., Waterloo Road, Clitheroe, Lancs.	"Century" A.1	Portable	21×25⅝×10	3 kW	3-heat rotary switch and thermostat	Steel plate and vitreous cast iron	Vitreous enamel	£20 3 0	£3 13 0
	"Century" B.1	Portable	21×13×10	1½ kW	Two tumbler switches and thermostat	Steel plate and vitreous cast iron	Vitreous enamel	£12 11 3	£2 5 4
E. K. COLE, LTD., Heating Division, 5, Vigo Street, London, W.1.	FRC1	Portable	23×16½×9½	1 kW	Thermostatic	Plastic	Polished walnut or black (ivory, beige or red 10s extra plus 1s 10d P.T.)	£10 0 0	£1 16 2
	FR2 and FRC2	Portable	23×25½×9½	2 kW	Half-heat (FR2) thermostatic (FRC2)	Plastic	Polished walnut or black (ivory, beige or red 15s extra plus 2s 9d P.T.)	£11 10 0 (FR2) £12 10 0 (FRC2)	£2 1 7 (FR2) £2 5 2 (FRC2)
	K2 and KC2	Portable	23½×23×7½	2 kW	Half-heat (K2) thermostatic (KC2)	Steel	Hammered bronze stoved enamel	£7 0 0 (K2) £7 10 0 (KC2)	£1 5 4 (K2) £1 7 1 (KC2)
	SR15 and SRC15	Portable or wall fixing	23×15½×8½	1½ kW	None (SR15) thermostatic (SRC15)	Steel	Light bronze stoved enamel	£8 5 0 (SR15) £9 15 0 (SRC15)	£1 9 10 (SR15) £1 15 3 (SRC15)
	SR2 and SRC2	Portable or wall fixing	23×24½×8½	2 kW	Half-heat (SR2) thermostatic (SRC2)	Steel	Light bronze stoved enamel	£10 10 0 (SR2) £11 10 0 (SRC2)	£1 17 11 (SR2) £2 1 7 (SRC2)
	SR3 and SRC3	Portable or wall fixing	23×24½×8½	3 kW	Half-heat (SR3) thermostatic (SRC3)	Steel	Light bronze stoved enamel	£11 10 0 (SR3) £12 10 0 (SRC3)	£2 1 7 (SR3) £2 5 2 (SRC3)
	B1 and BC1	Inset	22½×14½×1⅛ (panel) 18½×12⅝×5½ (recess)	1 kW	External switch required (B1) thermostatic (BC1)	Plastic panel, steel grilles	Walnut or black panels (ivory, beige or red 15s extra plus 2s 9d P.T.)	£12 0 0 (B1) £13 10 0 (BC1)	£2 3 4 (B1) £2 8 9 (BC1)
	B2 and BC2	Inset	22½×23½×1⅛ (panel) 18½×21×5½ (recess)	2 kW	External switch required (B2) thermostatic (BC2)	Plastic panel, steel grilles	Walnut or black panels (ivory, beige or red £1 extra plus 3s 8d P.T.)	£15 10 0 (B2) £16 10 0 (BC2)	£2 14 2 (B2) £2 19 7 (BC2)
	RGP1 and RGP1/P	Radiant glass wall panel, portable or wall fixing	21¼×30½×3	1 kW	External switch required, built-in switch available to order	Armour plate glass	Light bronze frame	£11 0 0 (RGP1) £11 10 0 (RGP1/P)	£1 19 9 (RGP1) £2 1 7 (RGP1/P)
	WMC125 and WM125	Wall mounting	17½×22⅝×5½	1½ kW	Thermostatic (WMC125) non-thermostatic (WM125)	Steel	Light hammered bronze	£9 17 6 (WMC125) £8 15 0 (WM125)	£1 15 8 (WMC125) £1 11 7 (WM125)
	WMC25 and WM25	Wall mounting	26½×22⅝×5½	2½ kW	Thermostatic (WMC25) non-thermostatic, 2-heat switch (WM25)	Steel	Light hammered bronze	£11 8 6 (WMC25) £10 10 0 (WM25)	£2 1 3 (WMC25) £1 17 11 (WM25)
CROSSLANDS (RUGELEY), LTD., 55, Ebury Street, London, S.W.1.	900/1	Portable	22½×23½×3½–5	1 kW	—	Steel	Old gold or antique bronze	£6 12 6	£1 3 11
	900/2	Portable	22½×23½×3½–5	2 kW	Half-heat switch or variable thermostat	Steel	Old gold or antique bronze	£8 0 0 (switched) £9 5 0 (thermostat)	£1 8 11 (switched) £1 13 5 (thermostat)
	900/3	Portable	22½×23½×3½–5	2 kW	3-heat switch	Steel	Old gold or antique bronze	£8 18 0	£1 12 2

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
DEXRAY ENGINEERING CO., LTD., 34, Ardwick Green South, Manchester, 13.	C.20	Portable	25×18×6	2 kW	On/off switch	Steel	Stove enamelled	£7 13 4	£1 8 9
	C.22	Portable	25×18×8	2 kW	On/off switch	Steel	Stove enamelled	£7 18 0	£1 9 7
	C.20/W	Wall mounting	23×18×7½	2 kW	On/off switch	Steel	Stove enamelled	£7 18 0	£1 9 7
DIMPLEX, LTD., Millbrook, Southampton.	A.38	Panel, oil-filled: supplied with feet or wall brackets	20½ (+2 with feet) ×26×7½ (feet), 3½ (brackets) or 12 (castors)	500 W	Thermostatic, pilot light	Sheet steel	Standard colours: bronze, gold, cream or white stoved enamel. Available to order: sky blue, pink, eau-de-nil, light grey or red.	£10 0 0	£1 16 6
	B.48	Panel, oil-filled: supplied with feet or wall brackets	26½ (+2 with feet) ×26×7½ (feet), 3½ (brackets) or 12 (castors)	750 W	Thermostatic, pilot light	Sheet steel		£12 0 0	£2 4 0
	B.310	Panel, oil-filled: supplied with feet or wall brackets	20½ (+2 with feet) ×31½×7½ (feet), 3½ (brackets) or 12 (castors)	750 W	Thermostatic, pilot light	Sheet steel		£12 0 0	£2 4 0
	B.216	Panel, oil-filled: supplied with feet or wall brackets	14½ (+2 with feet) ×47½×7½ (feet), 3½ (brackets) or 12 (castors)	750 W	Thermostatic, pilot light	Sheet steel		£12 0 0	£2 4 0
	C.412	Panel, oil-filled: supplied with feet or wall brackets	26½ (+2 with feet) ×36½×7½ (feet), 3½ (brackets) or 12 (castors)	1 kW	Thermostatic, pilot light	Sheet steel		£14 0 0	£2 11 3
	C.220	Panel, oil-filled: supplied with feet or wall brackets	14½ (+2 with feet) ×57½×7½ (feet), 3½ (brackets) or 12 (castors)	1 kW	Thermostatic, pilot light	Sheet steel		£14 0 0	£2 11 3
	ER.316	Panel, oil-filled: supplied with feet or wall brackets	20½ (+2 with feet) ×47½×7½ (feet), 3½ (brackets) or 12 (castors)	1¼ kW	Thermostatic, pilot light	Sheet steel		£16 0 0	£2 18 6
	D.416	Panel, oil-filled: supplied with feet or wall brackets	26½ (+2 with feet) ×47½×7½ (feet), 3½ (brackets) or 12 (castors)	1½ kW	Thermostatic, pilot light	Sheet steel		£18 0 0	£3 5 9
	D.320	Panel, oil-filled: supplied with feet or wall brackets	20½ (+2 with feet) ×57½×7½ (feet), 3½ (brackets) or 12 (castors)	1½ kW	Thermostatic, pilot light	Sheet steel		£18 0 0	£3 5 9

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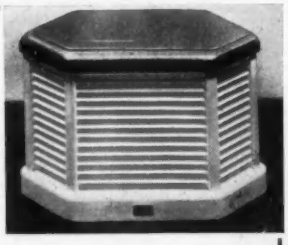

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7. *Bescol model 272 "Contemporary" heater*
8. *Berry's "Solano" fan heater*
9. *Crosslands model 900/2 convector*
10. *E. K. Cole type WM wall mounting heater*
11. *Century model A.1 twin-panel convector*
12. *Dexray model C.22 convector*

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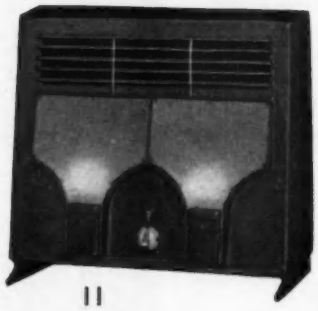

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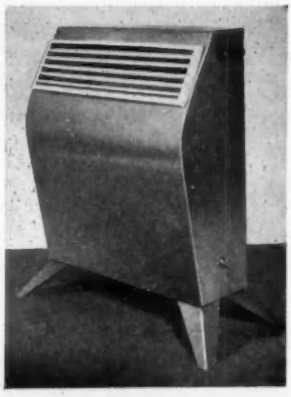

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
DIMPLEX, LTD., Millbrook, Southampton. (*continued*)	E.420	Panel, oil-filled: supplied with feet or wall brackets	26½ (+2 with feet) × 57⅞ × 7½ (feet), 3½ (brackets) or 12 (castors)	2 kW	Thermostatic, pilot light	Sheet steel	Standard colours: bronze, gold, cream or white stoved enamel. Available to order: sky-blue, pink, eau-de-nil, light grey or red.	£22 0 0	£4 0 6
	100	Column, oil-filled: supplied with feet or wall fixing bolt	21 (+3½ with feet) × 18⅞ × 6 (feet) or 12 (castors)	1 kW	Thermostatic, pilot light	Steel		£16 10 0	£3 0 3
	140	Column, oil-filled: supplied with feet or wall fixing bolt	21 (+3½ with feet) × 24⅞ × 6 (feet) or 12 (castors)	1½ kW	Thermostatic, pilot light	Steel		£20 10 0	£3 15 0
	180	Column, oil-filled: supplied with feet or wall fixing bolt	21 (+3½ with feet) × 30⅞ × 6 (feet) or 12 (castors)	2 kW	Thermostatic, pilot light	Steel		£25 10 0	£4 13 3
	270	Column, oil-filled: supplied with feet or wall fixing bolt	21 (+3½ with feet) × 45 × 6 (feet) or 12 (castors)	3 kW	Thermostatic, pilot light	Steel		£35 0 0	£6 8 0
	ACH.300	Panel, oil-filled: supplied with feet or wall brackets	14⅜ × 25 × 2½ (brackets) or 5⅞ (feet)	300 W	Excess temperature cut-out	Sheet steel		£6 0 0	£1 2 0
	ETC.210	Panel, oil-filled: supplied with feet or wall brackets	14⅜ × 30½ × 2½ (brackets) or 5⅞ (feet)	450 W	Excess temperature cut-out	Sheet steel		£7 10 0	£1 7 6
	SBS 300/W (a) SBS 300/F (b) SBS 500/W (c) SBS 500/F (d)	Skirting board	5 × 24 × 2½ (a) 7½ × 24 × 4½ (b) 5 × 36 × 2½ (c) 7½ × 36 × 4½ (d)	300 W (a and b) 500 W (c and d)	—	Sheet steel		£3 17 6 (a) £4 2 6 (b) £4 12 6 (c) £4 17 6 (d)	£0 14 3 (a) £0 15 0 (b) £0 17 0 (c) £0 17 9 (d)
THOS. DRYDEN & SON, LTD., Grimshaw Street, Preston.	"AIRO-S" ARO/500/S and ARO/750/S	Portable	18½ × 13½ × 2	500 W and 750 W	Switch	Steel	Cream, silver, green, brown, grey and white	£3 17 6 (500 W) £4 2 6 (750 W)	£0 14 2 (500 W) £0 15 1 (750 W)
	"AIRO-S" ARO/1000/S and ARO/1500/S	Portable	18½ × 27 × 2	1 & 1½ kW	Switch	Steel	Cream, silver, green, brown, grey and white	£6 7 6 (1 kW) £6 15 0 (1½ kW)	£1 3 4 (1 kW) £1 4 8 (1½ kW)
	"AIRO-LS" ARO/250/LS, ARO/500/LS and ARO/750/LS	Portable, Low surface temperature only	18½ × 13½ × 2 (250 W) 18½ × 27 × 2 (500 and 750 W)	250 W, 500 W and 750 W	Switch	Steel	Cream, silver, green, brown, grey and white	£3 17 6 (250 W) £6 2 6 (500 W) £6 7 6 (750 W)	£0 14 2 (250 W) £1 2 5 (500 W) £1 3 4 (750 W)

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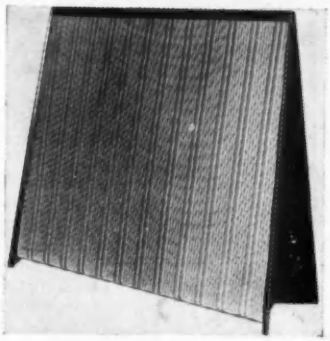
13. *Electroway Heaters model 83T convector*
14. *G.E.C. model D.2842 "Cosyvec" convector*
15. *Thos. Dryden "Airo" 500W radiator fitted with double towel rail*
16. *Dimplex model B.48 oil-filled radiator fitted with top-plate*
17. *G.B.M. oil-filled radiator*
18. *Falk, Stadelmann "Caprice" panel convector*



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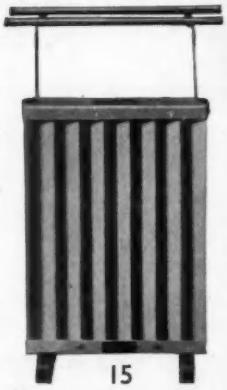

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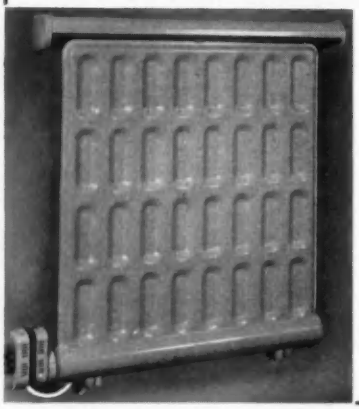

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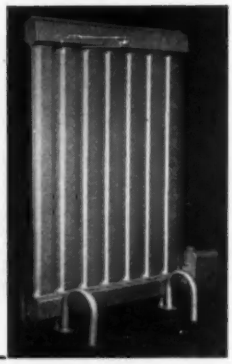

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Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
DULRAE, LTD., Griffin Lane, Aylesbury, Bucks.	"Medrae" CS	Panel, wall or ceiling mounting	23¾ × 11⅜ × ¼	175 W	Thermostatic	Non-metallic	Grey/brown	£1 18 8	£0 7 1
	"Medrae" CT	Panel, wall or ceiling mounting	23¾ × 15⅜ × ¼	250 W	Thermostatic	Non-metallic	Grey/brown	£2 4 0	£0 8 0
	"Medrae" CU	Panel, wall or ceiling mounting	23¾ × 23⅜ × ¼	425 W	Thermostatic	Non-metallic	Grey/brown	£2 17 8	£0 10 6
	"Medrae" CV	Panel, wall or ceiling mounting	31⅜ × 11⅜ × ¼	250 W	Thermostatic	Non-metallic	Grey/brown	£2 4 0	£0 8 0
	"Medrae" CW	Panel, wall or ceiling mounting	31⅜ × 23¼ × ¼	550 W	Thermostatic	Non-metallic	Grey/brown	£3 11 8	£0 13 1
	"Medrae" CX	Panel, wall or ceiling mounting	47⅜ × 7⅜ × ¼	250 W	Thermostatic	Non-metallic	Grey/brown	£2 4 0	£0 8 0
	"Medrae" CY	Panel, wall or ceiling mounting	47⅜ × 11⅜ × ¼	400 W	Thermostatic	Non-metallic	Grey/brown	£2 17 8	£0 10 6
	"Medrae" CZ	Panel, wall or ceiling mounting	47⅜ × 23⅜ × ¼	850 W	Thermostatic	Non-metallic	Grey/brown	£4 18 4	£0 18 0
	Note: All above panels are usually de-rated to half or one-quarter of the standard loadings for ceiling applications.								
ELECTROWAY HEATERS, LTD., Loughborough, Leics.	81 and 81S	Portable. Can be converted to wall mounting	25 × 15 × 10	1 kW	Half-heat switch (81S only)	Sheet steel	Golden beige	£4 19 6 (81) £5 7 0 (81S)	£0 18 3 (81) £0 19 8 (81S)
	82T and 83T	Portable. Can be converted to wall mounting	25 × 26 × 10	2 kW and 3 kW	Thermostatic	Sheet steel	Golden beige	£7 18 0 (82T) £11 5 0 (83T)	£1 9 0 (82T) £2 1 3 (83T)
FALK, STADELMANN & CO., LTD., 91, Farringdon Road, London, E.C.1.	"Caprice" U.9571S	Portable panel	20¾ × 22⅛ × 3⅛	2 kW	Step	Steel	Vitreous enamelled in five contemporary colours. Chromium feet and band	£10 8 6	£1 18 2
H. FROST & CO., LTD., Fieldgate, Walsall.	"Sunhouse" 5100	Portable	22⅛ × 8 × 8	1 kW	—	Pressed steel	Copper bronze	£4 16 0	£1 0 10
	"Sunhouse" 5200 and 5201	Portable	22⅛ × 16 × 8	2 kW	Half or full-heat a.c. switch (5200) Thermostatic (5201)	Pressed steel	Copper bronze	£7 0 0 (5200) £7 18 6 (5201)	£1 5 3 (5200) £1 8 7 (5201)
G.B.M. (ELECTRICAL) BIRMINGHAM, LTD., 439, Moseley Road, Birmingham, 12.	P.1	Panel oil-filled	27⅛ × 21⅛ × 2	500 W	Thermostatic	Pressed steel	Hammered gold	£9 5 0	£1 10 0
	P.2	Panel oil-filled	27⅛ × 28⅜ × 2	750 W	Thermostatic	Pressed steel	Hammered gold	£11 10 0	£1 17 4
	P.3	Panel oil-filled	27⅛ × 35⅝ × 2	1 kW	Thermostatic	Pressed steel	Hammered gold	£13 10 0	£2 3 10
	P.4	Panel oil-filled	27⅛ × 49⅞ × 2	1½ kW	Thermostatic	Pressed steel	Hammered gold	£16 17 6	£2 14 10
	P.5	Panel oil-filled	33⅛ × 61⅝ × 2	2 kW	Thermostatic	Pressed steel	Hammered gold	£21 10 0	£3 9 10
	C.1	Column oil-filled	18(+2 for castors) × 21 × 5	500 W	Thermostatic	Steel	Hammered gold	£9 17 6	£1 12 1
	C.2	Column oil-filled	24(+2 for castors) × 24⅛ × 5	1 kW	Thermostatic	Steel	Hammered gold	£15 10 0	£2 10 4
	C.3	Column oil-filled	24(+2 for castors) × 35½ × 5	1½ kW	Thermostatic	Steel	Hammered gold	£19 10 0	£3 3 4
	C.4	Column oil-filled	24(+2 for castors) × 44 × 5	2 kW	Thermostatic	Steel	Hammered gold	£24 10 0	£3 19 7
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.	D.2802	Portable	27 × 17 × 7	1 kW	On-off switch	Steel	Hammered bronze	£5 10 9	£1 0 3
	D.2806	Portable	27 × 17 × 17	1·5 kW	2-heat switch	Steel	Hammered bronze	£7 7 11	£1 7 1
	D.2804	Portable	27 × 23 × 7	2 kW	Thermostatic	Steel	Hammered bronze	£8 18 5	£1 12 7
	"Cosyvec" D.2842	Portable	21⅛ × 29 × 8⅛	2 kW	Thermostatic	Steel with "Expamet" grille	Black and gold	£8 18 5	£1 12 7
	"Cosyrad" D.2805	Portable or wall mounting	25 × 27 × 6½	1·5 kW	Thermostatic	Sheet metal frame with "Expamet" grille	Black, gold and burgundy	£12 2 3	£2 4 3
	DM.248	Portable or wall mounting fan heater	15 × 12 × 7¾	2 kW	Fan direct to the mains, switches for 1 or 2 kW	Sheet steel with chromium legs	Grey, red or honeysuckle with black handle	£9 14 11	£1 15 7

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
ALFRED GRAHAM & CO., LTD., Washer Lane Works, Halifax, Yorks.	"Wafer" D121L (a) and D121S (b)	Wall mounting	24×13⅜×5⅜	1 kW	Unswitched (a) or switched (b)	Steel	Bronze or ivory	£7 7 0 (a) £8 3 0 (b)	£1 6 10 (a) £1 9 9 (b)
	"Wafer" D122L (a), D122S (b) and D122H (c)	Wall mounting	24×23⅜×5⅜	2 kW	Unswitched (a), switched (b) or 3-heat switch (c)	Steel	Bronze or ivory	£9 10 0 (a) £10 6 0 (b) £11 2 0 (c)	£1 14 8 (a) £1 17 7 (b) £2 0 6 (c)
	"Wafer" D123L (a) D123S (b) and D123H (c)	Wall mounting	24×23⅜×5⅜	1½ kW	Unswitched (a), switched (b) or 3-heat switch (c)	Steel	Bronze or ivory	£9 2 0 (a) £9 17 6 (b) £10 13 6 (c)	£1 13 3 (a) £1 16 1 (b) £1 19 0 (c)
	"Penguin"	Portable	23×15×7 (a) 23×19×7 (b)	1 kW (a) 2 kW (b)	Half-heat switch	Steel	Two-tone colour range	£7 4 3 (a) £7 17 0 (b)	£1 6 4 (a) £1 8 8 (b)
L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, London, W.C.2.	LGH.452	Portable	28½×12×8½	1 kW	—	Sheet steel	Pink, eau-de-nil, ivory, gold, white or mushroom	£5 5 9	£0 19 4
	LGH.453S	Portable	28½×14×8½	2 kW	Switch	Sheet steel	Pink, eau-de-nil, ivory, gold, white or mushroom	£6 11 0	£1 3 11
	LGH.454T	Portable	28½×14×8½	2 kW	Thermostatic	Sheet steel	Pink, eau-de-nil, ivory, gold, white or mushroom	£7 4 3	£1 6 4
	"Sunray" LGH.451	Portable	21×13×6	1 kW	—	Sheet steel	Hammered gold and ivory	£4 17 0	£0 17 9
	"Sunray" de-luxe LGH.456T	Portable	28½×14×8½	2 kW	Thermostatic	Sheet steel	Hammered gold and ivory	£10 18 11	£2 0 0
	"Sunray" de-luxe LGH.455T	Portable	28½×19½×8½	3 kW	Thermostatic	Sheet steel	Hammered gold and ivory	£18 4 11	£3 6 9
HEATOVENT ELECTRIC, LTD., Lomond Street, Glasgow, N.2.	Metal	Portable	16×15½×5½ to 23×24×6	1 to 3 kW	Full or half-heat switches or thermostatic	Steel	Brown, gold or bronze	£7 0 0 to £14 0 0	£1 5 8 to £2 11 4
	Console	Portable	23×21¾×6½	2 kW	Full or half-heat switches or thermostatic	Wood veneer	Mahogany, walnut or oak	£12 0 0 to £13 0 0	£2 3 11 to £2 7 8
HEATRAE, LTD., Heatrae Works, Norwich.	321	Floor mounting	34½×18½×6½	1 kW	By arrangement	Steel	Brown or bronze	£10 12 0	£1 18 9
	322	Floor mounting	34½×29×6½	2 kW	By arrangement	Steel	Brown or bronze	£17 1 6	£3 2 5
	323	Floor mounting	34½×41×6½	3 kW	By arrangement	Steel	Brown or bronze	£20 19 0	£3 16 7
	2410	Wall mounting	30½×14×5	1 kW	By arrangement	Steel	Brown or bronze	£9 19 6	£1 16 9
	2420	Wall mounting	30½×26×5	2 kW	By arrangement	Steel	Brown or bronze	£16 4 0	£2 19 3
	2430	Wall mounting	30½×38×5	3 kW	By arrangement	Steel	Brown or bronze	£19 16 0	£3 12 5

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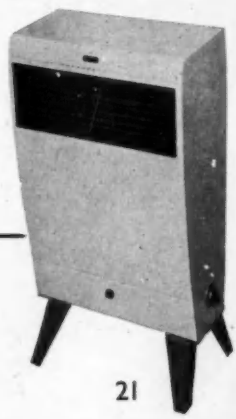
19. *Graham "Penguin" convector*

20. *Heatovent console convector*

21. *Hawkins model LGH.454T 2 kW convector*



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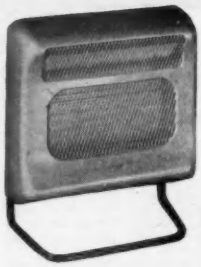

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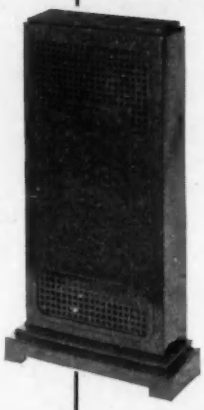
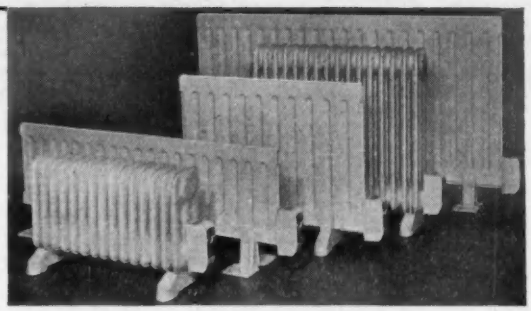
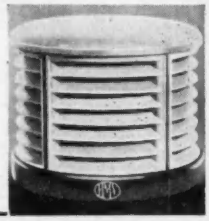




22. *Hobourn portable convector*
23. *Heatrae floor mounting convector*
24. *Column and panel oil-filled radiators from the Hurseal range*
25. *Hi-Fi "Hi-Stat" fan heater*
26. *H.M.V. "Cavendish" fan heater*



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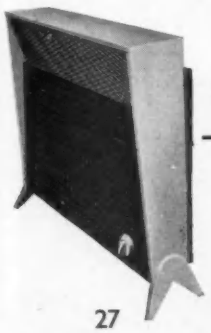
Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
HEATRAE, LTD., Heatrae Works, Norwich. *(continued)*	PC2/A	Floor mounting	24×18×7	2 kW	Hand switch	Steel	Lustre mushroom	£7 15 0	£1 8 4
	PC2/B	Floor mounting	24×18×7	2 kW	Thermostatic	Steel	Lustre mushroom	£8 12 2	£1 11 6
HI-FI, LTD., Derry Street, Brierley Hill, Staffs.	"Hi-Zee"	Fan heater	14×9½×6	1 & 2 kW	Switch (4 warm air and 2 cold air positions)	Steel	Stove enamelled, beige and ivory	£6 15 0	£1 4 8
	"Hi-Stat"	Fan heater	14×9½×6	1 & 2 kW	Switch (4 warm air and 2 cold air positions) and thermostat	Steel	Stove enamelled, beige and ivory	£8 8 0	£1 10 8
H.M.V. HOUSEHOLD APPLIANCES, Hayes, Middx.	"Cavendish" HCS.2	Fan heater	11½×13½×11	2 kW	Half-heat and heat-off switch	Plastic, metal base	Cream and black, cream and brown or walnut	£8 8 8	£1 10 10
	"Salisbury" HC.4 and HCT.4	Fan heater	15×11×7	2 kW	3 fan speeds, 3-heat switch	Metal, plastic base	Stone and black, red and black or gold and ivory	£6 17 9 (HC.4) £8 3 7 (HCT.4)	£1 5 3 (HC.4) £1 9 11 (HCT.4)
HOBOURN DOMESTIC APPLIANCES, LTD., Strood, Rochester, Kent.	W.H./1, W.H./2 and W.H./3	Wall mounting	18×19⅝×4¼	1½ kW or 2 kW	On/off (W.H./1) Unswitched (W.H./2) Thermostat (W.H./3)	Steel	Stoved enamel colours	£5 16 0 (W.H./1) £5 5 0 (W.H./2) £6 10 0 (W.H./3)	£1 1 2 (W.H./1) £0 19 2 (W.H./2) £1 3 9 (W.H./3)
	P.W.H./2	Portable	22½×19½×5	1½ kW	Unswitched	Steel	Ivory or hammered gold	£6 8 0	£1 3 5
	P.W.H./1 and P.W.H./3	Portable	22½×19½×5	2 kW	Half-heat switch (P.W.H./1) Thermostat (P.W.H./3)	Steel	Ivory or hammered gold	£6 18 0 (P.W.H./1) £7 10 0 (P.W.H./3)	£1 5 3 (P.W.H./1) £1 7 5 (P.W.H./3)
	P.N.H./3 and P.C.H./2	Portable safety heater	17×19×5½	1,200 W	Safety cut-out	Steel	Pink or blue (P.N.H./3) or mushroom (P.C.H./2)	£6 10 0	£1 3 9
	"Ocean" 1	Oil-filled radiator	24½×19½×8	720 W	3-heat switch	Steel	Cream stoved enamel	£15 17 0	£2 17 11
	"Ocean" 2	Oil-filled radiator	26×26×8	1,200 W	3-heat switch	Steel	Cream stoved enamel	£17 5 10	£3 3 3
HURSEAL, LTD., 229, Regent Street, London, W.1.	HM½ HM¾	Oil-filled panel portable	20×29×[illegible] 20×41×[illegible]	½ kW ¾ kW	Built in thermostatic	Steel	Standard: bronze or cream with red trim. Ensemble finishes: white, gold, etc., also available.	£9 14 5 £11 16 8	£1 15 6 £2 3 3
	TV½ TV¾ TV1 TV1½	Oil-filled panel portable	26×29×[illegible] 26×29×[illegible] 26×41×[illegible] 26×52×[illegible]	½ kW ¾ kW 1 kW 1½ kW	Built in thermostatic	Steel		£9 14 5 £11 16 8 £13 18 11 £15 12 9	£1 15 6 £2 3 3 £2 11 0 £2 17 2
	HJ	Oil-filled 2-column portable	17×27×3¾	¾ kW	Built in thermostatic	Steel		£14 17 5	£2 12 6

(Continued on next page)

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
HURSEAL, LTD., 229, Regent Street, London, W.1. *(continued)*	TV3	Oil-filled 3-column portable	28×17×5½	1 kW	Built in thermostatic	Steel	Standard: bronze or cream stoved enamel. Eau-de-nil, sky blue, white, gold, etc., also available.	£17 15 0	£3 4 11
	J.05 J.75 J.10 J.15	Oil-filled 2-column portable, floor or wall fitting	17×20×3½ 17×27×3½ 17×38×3½ 17×53×3½	½ kW ¾ kW 1 kW 1½ kW	Built in thermostatic	Steel		£11 16 8 £14 7 5 £17 15 0 £22 16 6	£2 3 3 £2 12 6 £3 4 11 £4 3 5
	S.75 S.10 S.15	Oil-filled 3-column portable, floor or wall fitting	13×23×5½ 13½×29×5½ 13×43×5½	¾ kW 1 kW 1½ kW	Built in thermostatic	Steel		£14 7 5 £17 15 0 £22 16 6	£2 12 6 £3 4 11 £4 3 5
	F.11 F.12 F.13 F.14 F.15 F.16 F.17 F.18 F.19 F.20	Oil-filled 3-column, floor or wall fitting	21×14×5½ 21×22×5½ 24×20×5½ 28×17×5½ 21×31×5½ 24×28×5½ 28×25×5½ 21×41×5½ 24×36×5½ 28×31×5½	½ kW 1 kW 1 kW 1 kW 1½ kW 1½ kW 1½ kW 2 kW 2 kW 2 kW	Built in thermostatic	Steel		£11 16 8 £16 1 2 £17 15 0 £17 15 0 £20 5 9 £21 19 7 £21 19 7 £25 7 2 £27 1 0 £27 1 0	£2 3 3 £2 18 9 £3 4 11 £3 4 11 £3 14 2 £4 0 4 £4 0 4 £4 12 9 £4 18 11 £4 18 11
	P.1 P.2 P.3 P.4 P.5	Oil-filled panel, floor or wall fitting	18×29×2½ 24×24×2½ 18×52×2½ 24×41×2½ 30×36×2½	½ kW 1 kW 1 kW 1 kW 1 kW	Built in thermostatic	Steel		£9 14 5 £9 14 5 £13 18 11 £13 18 11 £13 18 11	£1 15 6 £1 15 6 £2 11 0 £2 11 0 £2 11 0
	P.6 P.7 P.8 P.9 P.10	Oil-filled panel, floor or wall fitting	18×78×2½ 24×59×2½ 30×50×2½ 30×69×2½ 24×78×2½	1½ kW 1½ kW 1½ kW 2 kW 2 kW	Built in thermostatic	Steel		£17 15 0 £17 15 0 £19 8 10 £22 16 6 £21 19 7	£3 4 11 £3 4 11 £3 11 1 £4 3 5 £4 0 4
	B.05 B.75 B.10 B.15	Oil-filled panel, floor or wall fitting	11×49×2½ 11×78×2½ 11×96×2½ 11×144×2½	½ kW ¾ kW 1 kW 1½ kW	Built in thermostatic	Steel		£11 16 8 £13 2 0 £16 9 8 £22 16 6	£2 3 3 £2 7 11 £3 0 3 £4 3 5
H.V.E. (ELECTRIC), LTD., Viaduct Works, Kirkstall Road, Leeds, 4.	" Bournemouth " DC.1.P and DC.1.V	Portable	23×24×6½	1 kW	—	Wood with steel case	Pastel colours or veneer	£9 15 0 (DC.1.P) £11 0 0 (DC.1.V)	£1 16 7 (DC.1.P) £2 1 3 (DC.1.V)
	" Bournemouth " DC.2.P and DC.2.V	Portable	23×24×6½	2 kW	—	Wood with steel case	Pastel colours or veneer	£10 5 0 (DC.2.P) £11 10 0 (DC.2.V)	£1 18 5 (DC.2.P) £2 4 2 (DC.2.V)
	" Bournemouth " DCR.2.P and DCR.2.V	Portable	23×24×6½	2 kW	Energy regulator	Wood with steel case	Pastel colours or veneer	£11 5 0 (DCR.2.P) £12 10 0 (DCR.2.V)	£2 2 2 (DCR.2.P) £2 6 11 (DCR.2.V)
	" Bournemouth " DC.3.P and DC.3.V	Portable	23×24×6½	3 kW	—	Wood with steel case	Pastel colours or veneer	£12 15 0 (DC.3.P) £14 0 0 (DC.3.V)	£2 7 10 (DC.3.P) £2 12 6 (DC.3.V)
	" Bournemouth " DCR.3.P and DCR.3.V	Portable	23×24×6½	3 kW	Energy regulator	Wood with steel case	Pastel colours or veneer	£13 16 0 (DCR.3.P) £15 0 0 (DCR.3.V)	£2 11 9 (DCR.3.P) £2 16 3 (DCR.3.V)
M. & J. LOSSOS & CO., LTD., 29-31, Beethoven Street, London, W.10.	" Kaloric Mayfair "	Cabinet	19¼×12½×6½	750 W or 1 kW	Thermostat extra	Steel	Bronze (a) or cream, red, yellow or old gold (b)	£6 15 0 (a) £7 10 0 (b)	£1 4 8 (a) £1 7 5 (b)
	" Kaloric Mayfair "	Cabinet	25¾×22×7	2 kW	Switch, thermostat extra	Steel	Bronze (a) or cream, red, yellow or old gold (b)	£10 10 0 (a) £11 10 0 (b)	£1 18 5 (a) £2 2 1 (b)
	" Kaloric Mayfair "	Cabinet	25¾×22×7	3 kW	Switch, thermostat extra	Steel	Bronze (a) or cream, red, yellow or old gold (b)	£12 0 0 (a) £13 0 0 (b)	£2 13 11 (a) £2 7 8 (b)
	" Kaloric Sapphire "	Floor or wall mounting	21¾×16½×5¾	750 W or 1 kW	Thermostat extra	Steel	Beige and old gold	£8 0 0	£1 9 3
	" Kaloric Sapphire "	Floor or wall mounting	21¾×25¾×5¾	2 kW or 3 kW	Switch, thermostat extra	Steel	Beige and old gold	£11 0 0 (2 kW) £14 0 0 (3 kW)	£2 0 3 (2 kW) £2 11 2 (3 kW)
MERSEYSIDE ENGINEERING, LTD., 14-20, South Castle Street, Liverpool, 1.	" Everest "	Portable fan heater	13¾×12¾×10	2 kW	Thermostatic	Steel and plastic	Six duo-tone colours	£8 8 6	£1 11 0
MIDLAND ELECTRIC MFG. CO., LTD., Tyseley, Birmingham, 11.	" Memvair "	Portable	24×22×6½	1 kW	Unswitched (a) Thermostatic (b)	Steel	Bronze	£7 13 0 (a) £9 7 0 (b)	£1 8 0 (a) £1 14 2 (b)
	" Memvair "	Portable	24×22×6½	1½ kW	Switch (a) Thermostatic (b)	Steel	Bronze	£8 12 0 (a) £9 15 0 (b)	£1 11 5 (a) £1 15 8 (b)

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
MIDLAND ELECTRIC MFG. CO., LTD., Tyseley, Birmingham, 11. (*continued*)	" Memvair "	Portable	24×32×6½	2 kW	Switch (a) Thermostatic (b)	Steel	Bronze	£12 10 0 (a) £13 13 0 (b)	£2 5 8 (a) £2 9 11 (b)
	" Memvair "	Portable	24×32×6½	3 kW	Switch (a) Thermostatic (b)	Steel	Bronze	£13 12 0 (a) £14 7 0 (b)	£2 9 9 (a) £2 12 6 (b)
	" Circulair "	Portable	22½×7½×7½	1 kW	—	Steel	Bronze, mushroom or eau-de-nil	£3 15 0	£0 13 9
	" Rotovair "	Portable	14×14⅝×10	2 kW	Switch	Wood outer, steel inner	Walnut or leathercloth in beige or maroon	£11 1 0	£2 0 5
	" Memvek "	Portable	23½×10⅝×6½	1 kW	Switch	Steel	Bronze, cream, mushroom, eau-de-nil or primrose	£4 12 0	£0 16 10
	" Memvek "	Portable	24×22×6⅞	2 kW	Switch (a) Thermostatic (b)	Steel		£6 17 0 (a) £7 14 0 (b)	£1 5 1 (a) £1 8 2 (b)
	" Memvek "	Portable	24×32½×6⅞	3 kW	Switch (a) Thermostatic (b)	Steel		£10 7 0 (a) £11 12 0 (b)	£1 17 10 (a) £2 0 7 (b)
	" Memvek "	Wall mounting	21⅛×10⅝×5⅞	1 kW	Switch	Steel		£4 2 0	£0 15 0
	" Memvek "	Wall mounting	21×22×5⅛	2 kW	Switch (a) Thermostatic (b)	Steel		£6 4 0 (a) £7 1 0 (b)	£1 2 8 (a) £1 5 9 (b)
	" Memvek "	Wall mounting	21×22×5⅛	3 kW	Switch (a) Thermostatic (b)	Steel		£9 13 0 (a) £10 8 0 (b)	£1 15 3 (a) £1 18 0 (b)
	" Memrad "	Portable	26⅛×26⅛×7	1 kW	—	Steel	Mushroom, red fittings	£6 12 0	£1 4 2
	" Memrad "	Portable	26⅛×41⅛×7	2 kW	—	Steel	Bronze, brown fittings, or mushroom, red fittings	£10 7 0	£1 17 10
MORPHY-RICHARDS, LTD., 50, Conduit Street, London, W.1.	FH	Portable fan heater	15×17×9	2 kW	Thermostatic, 2-heat switches, 3 fan speeds	Steel and plastic	Cinnamon, white with red reflector	£10 10 0	£1 17 11
	" Sheerline " SHL	Portable	18×20×8	2 kW	Thermostatic	Steel	Ember red, charcoal or blue	£6 5 0	£1 2 7
	" Derwent " QBA/10	Portable	24×16×5½	1 kW	Thermostatic	Steel	Warm bronze (a) or ember red, charcoal or pearl grey (b)	£6 10 0 (a) £6 15 0 (b)	£1 3 6 (a) £1 4 4 (b)
	" Derwent " QBA/20	Portable	24×31×5½	2 kW	Thermostatic	Steel	Warm bronze (a) or ember red, charcoal or pearl grey (b)	£9 13 6 (a) £9 18 6 (b)	£1 14 11 (a) £1 15 10 (b)
	" Conway " QU/10	Portable	27×17×9	1 kW	Unswitched	Steel	Ember red, charcoal, pearl grey or warm bronze	£5 5 0	£0 18 11
	" Conway " QS/20	Portable	27×22×9	2 kW	Half-heat switch	Steel		£6 10 0	£1 3 6
	" Conway " QT/20	Portable	27×22×9	2 kW	Thermostatic	Steel		£7 5 0	£1 6 2

(*Continued on next page*)



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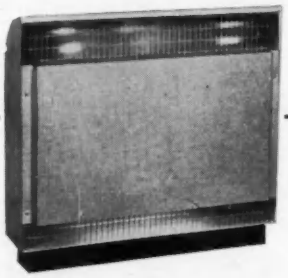

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27. *H.V.E. "Bournemouth" convector*

28. *M. & J. Lossos "Kaloric Sapphire" convector*

29. *M.E.M. "Circulair" portable heater*

30. *Morphy-Richards model FH portable fan heater*

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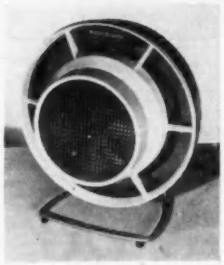

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
MORPHY-RICHARDS, LTD., 50, Conduit Street, London, W.1. (continued)	"Medway" QR/20	Portable	27×17×9	1 kW (convector) 1 kW (radiant)	Switch for fire	Steel	Warm bronze (a) or ember red, charcoal or pearl grey (b)	£7 0 0 (a) £7 5 0 (b)	£1 5 3 (a) £1 6 2 (b)
	"Medway" QR/30	Portable	27×22×9	2 kW (convector) 1 kW (radiant)	Switch (fire) Thermostatic (convector)	Steel		£8 15 0 (a) £9 0 0 (b)	£1 11 7 (a) £1 12 6 (b)
PIFCO, LTD., Watling Street, Manchester, 4.	"Warmasphere"	Portable fan heater	7½×12 dia.	2 kW	2-heat switch	Steel	White stoved enamel, red or blue canopy	£6 17 5	£1 5 1
RADIATION, LTD., ELECTRICAL DIVN., 255, North Circular Road, Neasden, N.W.10.	"Masterpiece" 785	Portable	23 7/16×23 5/16×7	2 kW	Thermostatic	Steel and aluminium	Anodised gold, pale green, pale blue, peach or red aluminium frame and centre panel	£10 10 0	£1 18 5
	"Masterpiece" 786	Portable	23 7/16×23 5/16×7	2 kW	Switch	Steel and aluminium		£9 10 0	£1 14 9
	"Heatwave" 777/6	Portable	18½×23½×8	2 kW	Thermostatic (777) or switch (776)	Sheet steel	Mushroom	£5 14 5 (777) £5 4 7 (776)	£1 1 0 (777) £0 19 2 (776)
REELEK APPLIANCES, LTD., Reelek Works, Baldock, Herts.	"Handy"	Portable	18×14×9½	1 kW	—	Steel	Mottled fawn, aluminium grille	£4 0 0	£0 14 5
	"Handy"	Portable	21½×20×9½	2 kW	Thermostatic	Steel	Mottled fawn, aluminium grille	£5 15 0	£1 0 9
	"Countess"	Portable	18×30×9½	2 kW	Thermostatic	Steel	Mottled fawn, aluminium grille	£8 5 0	£1 9 9
REVO ELECTRIC CO., LTD., Tipton, Staffs.	"Salisbury" FI4980	Portable	22½×15½×10½	1 kW	Unswitched	Steel	Welsh grey, pale gold or Cotswold stone	£5 10 0	£1 0 1
	"Salisbury" FI4984 and FI4985	Portable	22½×19½×10½	2 kW	Half-heat switch (FI4984) or thermostat (FI4985)	Steel	Welsh grey, pale gold or Cotswold stone	£7 5 0 (FI4984) £8 10 0 (FI4985)	£1 6 6 (FI4984) £1 11 1 (FI4985)
	"Winchester" FI4982 and FI4983	Portable	22½×15½×10½	1 kW (convector) and 1 kW (radiant)	Switch (radiant) (FI4982) Switch (radiant) and thermostat (convector) (FI4983)	Steel	Welsh grey, pale gold or Cotswold stone	£8 4 6 (FI4982) £9 9 6 (FI4983)	£1 10 1 (FI4982) £1 14 8 (FI4983)
	"Winchester" FI4986 and FI4987	Portable	22½×19½×10½	2 kW (convector) and 1 kW (radiant)	Switch (radiant) (FI4986) Switch (radiant) and thermostat (convector) (FI4987)	Steel	Welsh grey, pale gold or Cotswold stone	£9 18 6 (FI4986) £11 3 6 (FI4987)	£1 16 4 (FI4986) £2 0 10 (FI4987)
SIMPLEX ELECTRIC CO., LTD., Creda Works, Blythe Bridge, Staffs.	"Capri"	Portable	22½×25½×5½	1 kW	—	Steel	Four two-tone stove enamelled colours	£6 5 0	£1 2 10
	"Calypso" CH.354 and CH.355	Portable	26×12×7½ (750 W) 26×24½×7½ (2 kW)	750 W and 2 kW	Half-heat switch on 2 kW model	Steel	Various two-tone stove enamelled colours	£3 8 10 (CH.354) £6 18 4 (CH.355)	£0 12 7 (CH.354) £1 5 3 (CH.355)
THERMAIR DOMESTIC APPLIANCES, LTD., Izons Lane, Oldbury Road, West Bromwich.	"Vectron"	Portable	22½×7×7	2 kW	Half-heat switch	Aluminium and steel	Grey, gold, red and blue	£10 6 8	£1 17 10
UNITY HEATING, LTD., Chilworth Manor, Southampton.	"Conp" 1911 and 1921	Portable	24×27×5	1 kW	Thermostatic (1911) Unswitched (1921)	Steel	Bronze or grey	£12 5 0 (1911) £11 0 0 (1921)	£2 4 1 (1911) £1 19 7 (1921)
	"Conp" 1912 and 1922	Portable	24×27×5	2 kW	Thermostatic and 2-heat switch (1912) 2-heat switch (1922)	Steel	Bronze or grey	£13 0 0 (1912) £11 15 0 (1922)	£2 6 10 (1912) £2 2 4 (1922)
	"Conp" 1913 and 1923	Portable	28×30×5	3 kW	Thermostatic and 2-heat switch (1913) 2-heat switch (1923)	Steel	Bronze or grey	£14 5 0 (1913) £13 0 0 (1923)	£2 11 4 (1913) £2 6 10 (1923)
	"Wode" 1933	Portable	23×29×6	1½ kW	Thermostatic	Wood	Mahogany and light oak	£10 10 0	£1 17 10

Manufacturer	Name or Model	Type	Size (H.W. & D.) in inches	Element Loading	Method of Control	Casing	Finish	Price (excl. tax)	Purchase Tax
UNITY HEATING, LTD., Chilworth Manor, Southampton. *(continued)*	1951, 1952 and 1953	Inset wall panel	23⅜×24½ (panel) 20⅜×19½×5 (recess)	1, 2 & 3 kW	Separate thermostat	Steel	Bronze or grey	£14 10 0 (1 kW) £15 5 0 (2 kW) £16 10 0 (3 kW)	£2 12 2 (1 kW) £2 14 11 (2 kW) £2 19 5 (3 kW)
	1812, 1813, 1823, 1824 and 1836	Wall mounting panels	12×24×1½ to 30×66×1½	100 W to 1 kW	Separate thermostat	Steel	French grey	£7 10 0 to £26 0 0	£1 7 0 to £4 13 7
	1863 to 1866 and 1893 to 1896	Skirting board panels	6×36×1½ to 6×72×1½ and 9×36×1½ to 9×72×1½	60 W per foot run	Separate thermostat	Steel	French grey	£6 15 0 to £11 5 0	£1 4 4 to £2 0 6
WARDLE ENGINEERING CO., LTD., Old Trafford, Manchester, 16.	"Maxheat"	Portable	23¼×25⅜×7¼	2 kW	Regulator	Steel and wood	Enamelled pastel shades (a) or wood veneers (b)	£11 5 0 (a) £12 10 0 (b)	£2 1 3 (a) £2 5 8 (b)
WARMEX, LTD., 375, Milton Road, Cambridge.	"Warmex" WCT	Portable, wall or panel	39×26¾×1½	1 kW	Thermostats available as an extra	Pressed steel	Hammered bronze or colours	£7 3 0	£1 2 6
WELMEC CORPORATION, LTD., 147, Strand, London, W.C.2.	AEG "Airotherm 60"	Portable, combined radiant/ convector heater	21×24×7½	2 kW	Step switches	Vitreous enamelled steel, plastic handles	Blue, cream or mushroom	£9 9 6	£1 14 8

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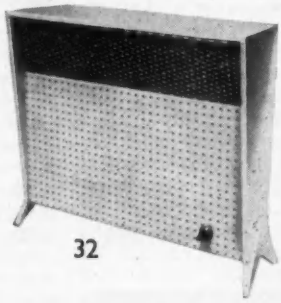

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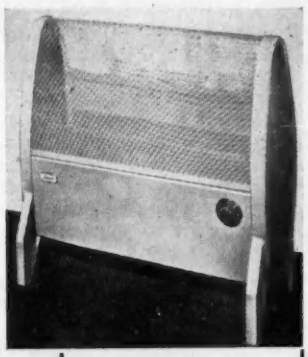

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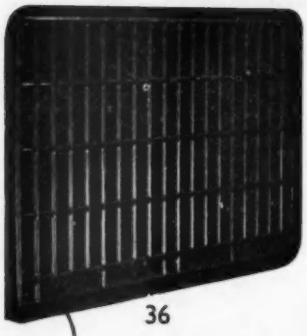

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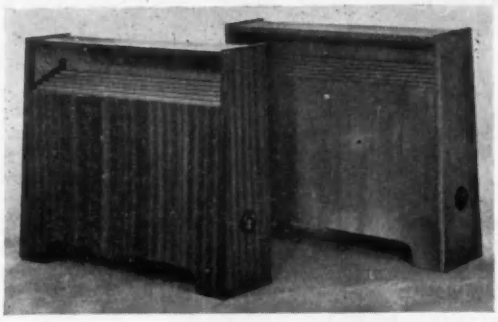

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31. *Welmec A.E.G. "Airotherm 60" combined radiant/ convector heater*
32. *Wardle "Maxheat" convector*
33. *Radiation "Heatwave" model 777/6 convector*
34. *Revo "Winchester" convector and radiant heater*
35. *Pifco "Warmasphere" fan heater*
36. *Warmex wall mounting radiator*
37. *Unity Heating "Wode" convectors (mahogany and light oak models)*
38. *Thermair "Vectron" portable heater*

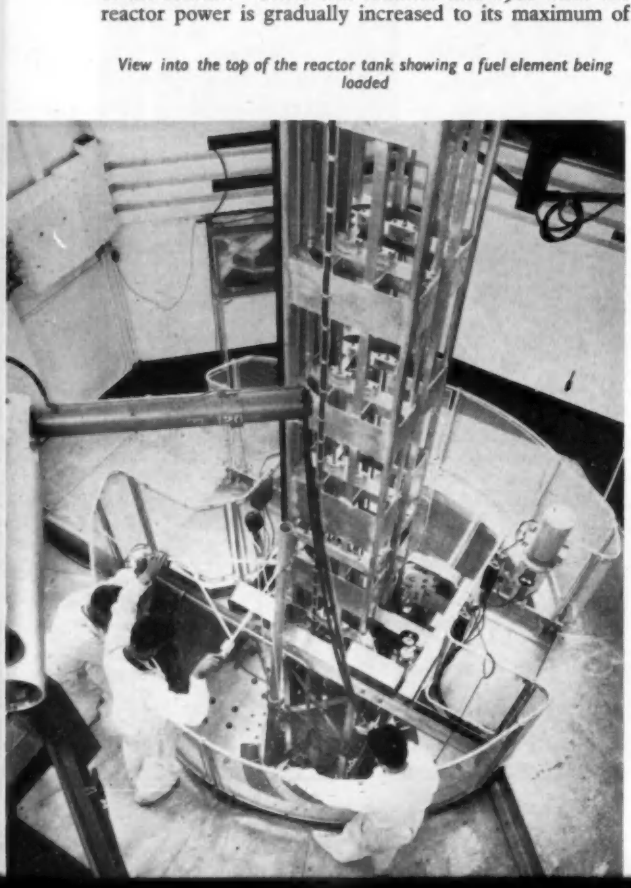
FIRST PRIVATE REACTOR

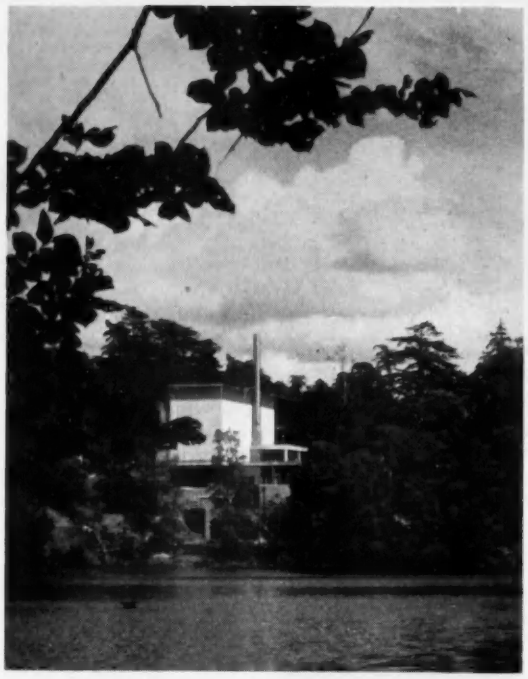
NUCLEAR ENERGY RESEARCH AT ALDERMASTON

THE first British privately-owned research reactor, MERLIN, at the fundamental research laboratory of Associated Electrical Industries, Ltd., at Aldermaston Court, became " critical " in July. This research laboratory was set up in 1947 with sections working on metallurgy, semiconductors, physics of surface and wear and nuclear sciences. Initially, the nuclear science group carried out work on control and instrumentation for reactor systems and two particle accelerators were installed before 1950. A second sub-division was formed in 1951 for research into the behaviour of very high current discharges in gases. In 1954, it was decided that research using neutrons would have to be considered and by 1955 a proposal to build a reactor was approved.

Since October, 1957, experiments have been carried out in the sub-critical laboratory on various reactor cores of less than critical size. These experiments provided much information on core behaviour for MERLIN, particularly with regard to critical masses, neutron distributions, the effect of absorbers and of temperature. The first fuel elements were loaded into the reactor on 6th July and the staff at Aldermaston are now engaged on proving trials of the reactor. These will continue into 1960 while the reactor power is gradually increased to its maximum of 5 MW. The reactor was built by the A.E.I.-John Thompson Nuclear Energy Co., Ltd., and the staff of the research laboratory shared in its design and erection.

View into the top of the reactor tank showing a fuel element being loaded





MERLIN reactor site at Aldermaston Court from the lake

It was originally designed as a 1 MW reactor and was re-designed to achieve 5 MW partly because there appeared to be a demand from overseas for a higher powered reactor and partly due to the shortage of test facilities in Britain. The fuel is uranium 235, which is supplied from Dounreay, and the reactor is light water moderated and cooled. Two novel features have been incorporated. Firstly, the core can be moved vertically to four positions. The top position permits the addition or withdrawal of fuel or experimental apparatus from the core. At two lower positions the core is in the plane of sets of experimental facilities and the lowest position is for storage of the core and is so arranged that the possibility of loss of coolant from the tank in this region is negligible. The other interesting feature of this reactor concerns the plugging of the tubes for the experimental facilities. Instead of heavy plugs which normally have to be removed by cranes, the tubes are sealed by pneumatically operated sliding lead doors and the shielding is completed by filling the tube with water. MERLIN is characterised by a large maximum fast (1 MeV) neutron flux per unit of power. The maximum unperturbed fast flux with 3·4 kg of U235 in the core is $6 \times 10^{13}/cm^2$.

Layout of Plant

The reactor and its associated buildings are close to Aldermaston lake water from which is used for secondary cooling. The main building contains the reactor and the experimental area, the reactor control room, the fission product detector and the ventilation plant. Nearer the lake are the primary and secondary coolant pump house, the sub-critical laboratory and the plant for processing liquid effluent by filtration and ion exchange. There are twenty fixed radiation monitors in the buildings and

effluent discharge systems and a further four are positioned symmetrically around the reactor at a distance of several hundred yards to give warning of any undue release of airborne radioactivity.

The research programme for MERLIN covers both the fundamental and applied aspects of reactor research and includes the study of the effects of radiation on materials, the study of Cerenkov radiation, the provision of nuclear data and methods of measuring neutron spectra and reactor control and safety studies. MERLIN will also play its part in the training of nuclear and reactor physicists and engineers.

Plasma Physics

As mentioned previously, the laboratory is also engaged in research into nuclear and plasma physics in collaboration with the A.E.R.E., Harwell. Partial success in stabilising gas discharge has been achieved in the aluminium torus known as Sceptre III. A new machine, Sceptre IV, is about to begin its commissioning period.

STRIP MILL MOTORS

New Equipment at Ebbw Vale Works

DURING the re-motoring of the continuous strip mill at the Ebbw Vale works of Richard Thomas & Baldwins, Ltd., an operation requiring the mill to be out of commission for only twenty days, 1,500 tons of equipment was removed and replaced by new machinery, including motors totalling 3,600 h.p. The new main motors, five of 4,000 h.p. and one of 3,000 h.p., are force ventilated, air entering the driving end. About 10 per cent of the volume is fed over the commutators and ducted into the mill to remove carbon dust, while the remainder is recirculated through a cooler.

There are six groups of rectifiers, totalling 19,800 kW. Each comprises four cylinders arranged in pairs sharing a d.c. circuit-breaker, enabling any one pair to be disconnected. Each of the group transformers, rated at 3,300 kW, consists of two units in a tank, one having a three-phase star-connected primary winding, the other being delta-connected. These are associated with four secondary windings to give a 12-phase output at 810 V r.m.s. Each primary excites a tertiary winding to supply rectifier excitation and arc suppression circuits. To avoid excessive harmonic interference being introduced into the supply system, the complete installation is arranged to give 36-phase rectification. A 240 kW loading resistor is provided for rectifier testing during the mill shut-down without interfering with machine maintenance. A smaller resistor enables an individual rectifier group to be tested while the remaining five are on load with the mill running. The rectifier supply is controlled by an 11 kV, 500 MVA switchboard, and on the d.c. side the equipment is protected by truck-type high-speed circuit-breakers, those associated with rectifiers being of 3,000 A capacity.

The six motors are accelerated simultaneously by raising the d.c. busbar voltage by rectifier grid control, speeds of the individual stands being adjusted by altering the excitation of the stand motors. The operation to be performed, inching, slow running, lining-up or rolling, is selected on the pulpit controls, and the control components are automatically set and checked. The first three operations are performed at low speed, determined only by busbar voltage, which is maintained by an automatic voltage regulator comprising a magnetic amplifier controlling the grid phase-shift network. Rolling is carried out at full voltage.

The protection system includes, in addition to overload, under-voltage and earth fault protection, 12 sets of double Buchholz equipments protecting the main and phase-displacement transformers and reactors. The rectifiers are equipped with high-speed arc suppression, initiated by d.c. pulse transformers in the cathode connections. Mill instrumentation is concentrated on the supervisory panel in the motor rooms where the availability of all essential supplies is indicated, with the state of all d.c. circuit-breakers. Stand drive armature currents and speeds are both indicated and recorded and the temperatures of stand drive bearings, their lubricating oil and the cooling water are available by operating a multi-point indicator. Field currents of the main drives and their associated control exciters are also shown. In the pulpit, the roll speed of each stand is shown and stand drive armature currents are indicated and recorded.

The main consultants for both electrical and civil work were Messrs. McLellan & Partners, with assistance in civil work by Messrs. W. S. Atkins & Partners. The principal contractors were the General Electric Co., Ltd., Davy & United, Ltd., Associated Electrical Industries, Ltd., and Sir Robert McAlpine & Sons, Ltd.

The first section entering the re-motored mill at the Ebbw Vale works of Richard Thomas & Baldwins, Ltd.

Financial Section

STOCKS and SHARES

THE past month was notable in the Stock Exchange firstly because of the unseasonably high rate of activity, and secondly because the average yield from leading British industrial shares fell below the gilt-edged yield, as represented by the return on 2½ per cent consols. On many past occasions this "yield gap" has narrowed to a small fraction, but this is the first time on record that the two lines have actually crossed. They did so as the result, on the one hand, of a fresh setback in the gilt-edged market, and on the other a rise in industrial share prices to yet another record height. It has, of course, long been the case that on the most popular industrial shares the investor has been prepared to accept smaller returns than those offered by long-dated Government stocks. Reference to the accompanying tables will show that many electrical shares are showing, on the basis of current dividends, yields much below the 4¾ per cent available at present from an investment in consols.

Domestic Equipment

Shares associated with the boom in domestic equipment and other consumer goods have continued to account for the greater part of the activity in the industrial market. Hoover were again very prominent, with a further rise of 4s to the £4 mark. Vactric were little further changed at 45s 6d. Radio and television manufacturers' shares generally maintained the sharp advance which marked the opening of the Radio Show, while the shares of rental, relay and hire-purchase firms were in high favour. Berry's Electric Magicoal were quoted ex the 50 per cent scrip issue; at 21s 3d the yield on the shares works out at nearly 4¾ per cent on the basis that the company finds it possible to maintain the present 20 per cent rate of dividend on the increased capital. Philips Lamps shares, which have an international following, rose well to 127s 6d on news of the 14 per cent rise in sales, and a proportionately larger expansion of profits, for the first half of this year.

Engineering Shares

In the heavy engineering sections, confidence was affected by the reduction of the John Thompson interim dividend from 10 to 7½ per cent: the company's statement says that the effects of the recession in the capital goods industries are still being felt, and that although welcome signs of improvement have now appeared, they may not be reflected in the figures for 1959. John Thompson shares were subsequently marked down by 1s 3d to 20s 6d. A.E.I. were lowered to about the same extent, to 61s 3d, but among the other major electrical groups G.E.C. were firm at 38s.

Electric Batteries

Chloride Electrical Storage shares reacted well to the company's decision to maintain the interim dividend at

Price Changes in

Company or Board	Nom. Value	Middle price 31st Aug.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1959 Highest	1959 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	78½x.d.	−½	3	3	3 16 6	80½	77½
Brit. Elec. 1974/77	100	75½	−½	3	3	3 19 6	77	74½
Brit. Elec. 1976/79	100	80	−½	3½	3½	4 7 6	80½	77½
Brit. Elec. 1974/79	100	88½	−1	4½	4½	4 16 0	91	87½
Overseas Electric Supply								
Calcutta Elec.	£1	19/-		6·8†	7†	11 18 0	19/6	16/-
East African Power	£1	20/6		7½	8	7 16 0	22/3	19/3
Nigerian Elec.	£1	14/6	+1/-	8	8	11 0 6	15/-	13/-
Perak Hydro-Elec.	£1	15/-		12½	10	13 6 9	15/-	12/3
Electrical Shares								
Aberdare Noldings	5/-	16/6	−3d	17½	17½	5 6 0	16/9	15/6
Aerialite	1/-	9/-	+3d	51½	54	6 0 0	9/6	7/9
Allen, W. H.	£1	513/		11	12	4 13 9	51/3	43/-
Allied Insulators	5/-	21/3	+1/-	—	20‡	4 14 0	21/6	18/9
Anglo-Portuguese Tel.	£1	29/6	+6d	9	9	6 2 0	29/6	26/6
Aron Elec. Ord.	£1	56/3		15	15	5 6 9	62/6	55/-
Assoc. Elec. Ord.	£1	61/3	−1/6	15	15	4 18 0	63/6	53/9
Automatic Tel. & El.	£1	75/-		17	17‡	4 10 9	82/6	71/3
Babcock & Wilcox	£1	52/6	−6d	13½	13	4 19 0	54/6	45/6
Bakelite	10/-	31/3		15	15	4 16 0	31/3	22/-
Baldwin, H. J.	2/-	2/6	+3d	20	20	—	3/-	2/3
Berry's Electric	5/-	21/3x.c.	+6d	10	20‡	4 14 0	22/-	7/3
Bowthorpe Holdings	2/-	14/9		25	27	3 13 0	15/6	11/9
British Elec. Traction: Def. Ord. "A"	5/-	40/6	+1/6	25	35	4 6 6	41/-	35/6
B.I. Callender's	£1	53/6	+6d	12½	13½	5 1 0	56/6	44/9
B.I. Callender's 6% Pref.	£1	20/6		6	6	5 17 0	20/6	19/9
British Thermostat	5/-	27/-	+1/6	30	35	3 5 0*	27/-	18/6
British Vac. Cleaner	5/-	7/9		10	7½*	4 16 9	7/9	4/6
Brook Motors	10/-	50/-		25	24½*	4 16 6	54/3	46/-
Bulgin, A. F.	1/-	10/3	+6d	45	50	4 17 6	10/3	6/9
Bulpitts	5/-	18/3		—	15	4 2 3	18/3	10/-
Burco Dean	5/-	15/9		22½	16*	5 1 6	15/9	12/3
Cable & Wireless: Ord.	5/-	16/-		10	10*	3 2 6	16/-	12/3
4% Loan	100	94½		4	4	4 4 9	95	93
Chloride El. Storage "A"	£1	59/6	+2/-	17½	20‡	4 9 6*	60/-	43/8
Clarke Chapman	£1	53/9		27½	13½*	5 2 3	66/3	52/6
Cole, E. K.	5/-	23/-	+6d	17½	20	4 7 0	23/6	17/3
Contactor Switchgear	5/-	15/-		20	14*	4 13 3	15/-	12/-
Cossor, A. C.	5/-	8/3		2½	Nil	Nil	9/-	6/3
Crabtree	10/-	30/3		20	20	6 12 3	31/6	28/-
Crompton Parkinson	5/-	14/3		16	12*	4 4 3	14/3	11/9
Davis & Timmins	5/-	17/-		18	20	5 17 9	17/-	14/6
De La Rue	10/-	51/-	−1/-	17½	20	3 18 6	54/-	30/3
Decca "A"	10/-	38/6	−3d	43½	50	5 4 0*	40/3	33/3
Dessoutter	5/-	27/6		32½	21½*‡	3 18 9	27/6	19/-
Dewhurst	2/-	8/-	−3d	20	20	5 0 0	8/3	7/3
Dictograph Tel.	2/-	7/6		20	20	5 6 9	8/3	7/-
Dubilier Condenser	1/-	4/6		20	25	5 11 0	5/-	3/3
Duport	5/-	13/3		25	12½*	4 14 3	13/3	10/3
E.M.I.	10/-	50/9	−1/-	15	20*‡	3 18 9	64/6	48/-
Electrical Apparatus	5/-	15/-	+1/3	12½	14½	4 16 9	15/-	13/-
Electrical Components	5/-	15/-	−9d	12½	15	5 0 0	15/9	10/6
Elec. Construction	£1	33/6		8½	9	5 7 6	33/6	27/9
Elliott-Automation	5/-	23/9		—	10‡	2 2 0	30/6	16/9
Enfield Cable Ord.	£1	21/3		2½	Nil	—	22/3	16/3
English Electric	£1	45/-		14	14	4 3 0*	45/-	37/10
English Electric 3½% Pref.	£1	13/-		3½	3½	5 15 6	12/9	12/3
Ericsson Tel.	5/-	22/3		12†	13†	5 1 6	27/3	22/3
Ever Ready	5/-	25/3	−9d	20	27½‡	3 5 6*	26/	13/3
Falk Stadelmann	£1	25/-		17½	10*‡	8 0 0	32/9	25/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

5 per cent, as before, on capital increased by a one-for-two scrip issue. Last year's total distribution of 20 per cent (including a special interim) is equivalent to 13½ per cent on the present capital. The £1 "A" shares added 2s to previous rises of 5s, reaching nearly 60s. Oldham & Son 1s shares have improved to about 3s since the appearance of the annual report, in which the chairman tells shareholders of the advantages now accruing from the policy of investment and development overseas. Although group profits contracted in 1958–9, the dividend was maintained at 17½ per cent for the fourth year in succession and was covered about twice by the net surplus of earnings. The yield on the shares is a fraction over 5¾ per cent.

Electrical Investments

Company or Board	Nom. Value	Middle price 31st Aug.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1959 Highest	1959 Lowest
Electrical Shares—continued								
G.E.C.	£1	38/-	+6d	10	10	5 5 3	40/3	31/3
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	22/-	20/3
General Cables	5/-	8/3		24	15	9 2 0	9/3	7/6
Greenwood & Batley	£1	105/-		20	30	5 14 3	105/-	75/-
Hackbridge Holdings	5/-	16/9	+3d	20	30	5 19 6	19/3	14/3
Hackbridge & Hewittic	5/-	13/6		20	20	5 11 0*	13/6	10/6
Head Wrightson	5/-	32/-		17½	20	3 2 6	32/-	24/3
Heatrae	2/-	8/-		20	20	5 0 0	10/-	7/6
Holophane	5/-	18/9		37½	22½*	6 0 0	18/9	14/9
Hoover	5/-	80/-	+4/-	50	60	3 15 0	81/6	55/-
I.C.I.	£1	42/-	+2/-	J2	8*	3 16 3	42/6	33/-
Intl. Combustion	5/-	35/-	+1/3	25	30‡	4 5 9	36/6	29/9
Intl. Computers & T.	£1	65/6		—	8‡	2 8 9	78/9	57/6
Johnson & Phillips	£1	22/-		5	5	4 11 0	30/6	22/-
Lancashire Dynamo	£1	43/9	+1/3	11	12½‡	4 6 0*	43/9	31/6
Laurence Scott	5/-	17/3	+6d	15	15	3 15 0*	17/3	14/-
Lister, R. A.	£1	40/6	+6d	10	12½	6 3 6	41/-	32/9
Lucas, J.	£1	54/6	−6d	7½	10‡	3 13 6	55/-	43/3
Marconi Marine	£1	42/-		10	10	4 15 3	48/6	40/-
Marryat & Scott	2/-	9/9		37½	22½*	4 12 3	10/-	8/6
Mather & Platt	£1	45/-	+6d	15	10‡*	4 14 9	51/6	41/3
Metal Industries	£1	55/3	−1/-	14	14	5 1 6	56/3	39/9
Midland Elec. Mfg.	£1	46/3	+3d	12½	10*	4 6 6	46/3	61/6
Morphy-Richards	4/-	29/9		20	20	2 13 9	30/6	18/-
Murex	£1	47/6	+1/3	17½	15	6 6 3	49/6	42/-
Newman Ind.	2/-	3/6		10	10	5 14 3	3/6	2/3
Oldham & Son	1/-	3/-	+3d	17½	17½	5 16 9	3/-	2/6
Parsons, C. A.	£1	48/3	−9d	7½	8½‡	3 7 3	55/9	45/9
Philips' Lamps	Fl.10	127/6	+5/-	14	14	2 2 0	130/-	88/-
Plessey	10/-	33/6	+6d	30	30	2 19 9*	33/6	23/6
Pye	5/-	15/6		12½	12½	4 0 9	16/9	13/9
Pyrotenax	5/-	38/-	+6d	—	34	4 9 6	38/3	33/9
Reliance Clifton	5/-	23/6	+6d	15	15	3 3 9	23/6	17/6
Reyrolle	£1	90/-		17½	17½	3 17 9	98/-	85/9
Rheostatic	4/-	10/6		12½	12½	4 15 3	10/9	8/3
Richardsons Westgarth	£0/-	12/6		8½	8½	6 13 0	15/3	12/-
Simon-Carves	5/-	29/6	+9d	25	25	4 4 9	32/-	28/6
Smith (England), S.	4/-	17/6		20	12½*‡	2 17 3	17/6	11/6
Southern Areas	£1	14/6		Nil	Nil	Nil	15/-	10/6
Strand Elec.	5/-	10/9		15	20	9 6 0	10/9	8/6
Sturtevant	5/-	18/-		15†	15†	6 16 0	20/-	17/-
Sun Elec.	5/-	16/3	+6d	25	25	3 17 0*	16/3	8/3
Switchgear & Cowans	5/-	13/9		22½	15*	5 9 0	13/9	10/3
T.C.C.	10/-	45/-	+1/3	25	25	5 11 0	45/-	38/-
Telephone Mfg.	5/-	6/3		10	10	8 0 0	6/3	4/9
Telephone Rentals	5/-	17/-		12½	12½*	3 13 6	17/-	11/9
Thompson (John)	5/-	20/6	−1/3	25	25	6 2 0	25/6	20/-
Thorn Elec.	5/-	39/6		17½	20	2 10 9	40/-	26/3
Thornycroft	£1	27/-	−6d	12½	7½	5 11 0	30/-	20/6
Tube Investments	£1	91/3	+1/3	15	17½	3 16 9	91/6	71/6
Vactric	5/-	45/6	−9d	25	37½	4 2 6	46/6	26/3
Veritys	5/-	1/6		12½	2½	—	5/-	1/3
Walsall Conduits	4/-	12/6		22½	22½	4 2 0*	14/2	10/8
Ward & Goldstone	5/-	46/3	+9d	25	30	3 4 9	46/3	30/6
Watford	2/-	9/6		25	25*	5 5 3	9/3	7/6
Westinghouse	£1	45/6	+2/-	10	10	4 8 0	47/-	39/6
West, Allen	5/-	12/9		12½	11½*	4 11 0	14/-	11/9
Wolf Electric	5/-	9/3	+1/-	10	10	5 8 0	9/3	7/9

G.E.C. Loan Stock

The General Electric Co. is issuing £8 million 6 per cent unsecured loan stock 1979–84, of which half has been offered to all classes of stockholders at par. In initial dealings the stock is £25 per cent paid up, with the balance of £75 per cent due by 22nd October, until when it will be transferable free of stamp duty. Interest dates are end March and September, with an initial payment of 57s 3d next March. With other loan stocks, annual interest requirements are covered 4½ times by the latest year's earnings and the principal amount 4 times by group net assets of £81·7 million. A circular to stockholders summarised the directors' view that increasing benefits from reorganisation, coupled with rising industrial activity, were likely to produce improved results in the present year.

Electrical Components

Business of the Electrical Components (Holdings) company benefited considerably in the latter part of the financial year ended in March from the relaxation of the credit and hire-purchase restrictions. An improvement of some 12 per cent in trading profits for the twelve months to £142,000, after tax, provided amply for an increase in the ordinary dividend from a total of 12½ to 15 per cent, the new rate being covered three times by net earnings. On prospects for the current year, the chairman says in the report that reliable guidance cannot be drawn from the figures in the opening months, but that the year started in quite a satisfactory manner, and he draws attention to the scale of the company's capital expenditure on new and enlarged premises. At 15s the 5s shares offer a 5 per cent yield.

British Thermostat Outlook

There has been good support for the 5s shares of British Thermostat since the distribution of the 100 per cent scrip issue. For last year the company reported improved earnings and was able to raise the total distribution on the ordinary shares from 30 to 35 per cent (including 5 per cent as bonus) while still retaining three quarters of the disposable net surplus in the business. Appropriations to reserve accounts raised these to £2 million, out of which £480,000 has now been capitalised through the scrip issue. This brings the ordinary capital to £960,000. At the annual meeting the chairman mentioned the entry of many newcomers into the company's field of activities as a factor which might result in some contraction of profits. At the same time he was confident about the company's ability to remain a leader in the field of automatic control.

REPORTS and DIVIDENDS

John Brown & Co., Ltd.—In the course of his statement to be presented at the annual meeting on 2nd October, Lord Aberconway (chairman) says that John Brown Land Boilers, Ltd., has had a busy year. The first of the six large boilers for the Central Electricity Generating Board's new Belvedere station has been steamed and a number of others for the Board are nearing completion, as well as two for the South of Scotland Board and others in South Africa. A contract has been obtained for a large boiler to complete the second half of the Bankside station, London.

The application of nuclear power continues to be watched with interest but the company's approach to this subject remains cautious. A contract has been obtained from the Atomic Energy Authority for the design and manufacture of the refuelling machine for the advanced gas-cooled reactor. This important piece of equipment involves the solution of a number of complex engineering problems.

In the field of portable electric tools, S. N. Bridges & Co., Ltd., has found trading conditions difficult both at home and overseas, the demand remaining low and competition intense. Recently, however, sales have somewhat improved. The introduction of new tools and attachments and sustained advertising have enabled the company to retain its place in the forefront of the electric tool business. The rebuilding and modernisation of the large works acquired in the previous year has almost been completed.

Electrical Components (Holdings), Ltd.—The chairman (Mr. L. S. Seccombe) reports that the company's turnover showed another substantial increase during the year ended 31st March last, thanks to purchase-tax and hire-purchase relaxations. On the other hand, the year had been a difficult one in respect of the company's purchasing operations; there had been a downward tendency in wholesale merchants' operating margins. The newly-acquired subsidiary, Santon (Wholesale), Ltd., had contributed a satisfactory amount to the profit in its ten months' activities within the group.

E. V. Industrials, Ltd.—The Camp Bird group has made an offer for the whole of the capital of this company which, among its holdings, numbers the Furse electrical contracting companies. The acquisition would be made by means of a share exchange involving a total amount of about £4·4 million. The E.V. directors have stated that they cannot recommend the offer.

Parmiter, Hope & Sugden, Ltd.—The company's annual meeting was held on 26th August. Reviewing the trading results, Mr. E. Sugden (chairman) said that orders received had been disappointingly less than the amount which the company could economically handle. He was optimistic, however, about the future. Though some five months of the current financial year had passed at more or less the sombre tone of the year under review, he could not see that they could fail to make a good recovery during the ensuing months.

Radio Rentals, Ltd.—To provide further permanent capital, it is proposed to make a "rights" issue of ordinary shares to existing shareholders. An extraordinary general meeting is to be held next Thursday at which a resolution will be presented recommending an increase in the authorised share capital to £3·5 million by the creation of two million additional 5s ordinary shares.

George H. Scholes & Co., Ltd., report an advance in net profit from £117,907 to £173,285 in the year ended 30th June last. The final dividend is increased from 14 to 24 per cent, raising the year's total from 20 per cent (plus a bonus of 5 per cent) to 30 per cent. It is proposed to make a one-for-two scrip issue.

International Combustion (Holdings), Ltd., has declared an interim dividend on the ordinary stock of 10 per cent, against 7½ per cent last year. It is stated that the increase has been made solely with a view to reducing the difference between the interim and final dividends.

John Thompson, Ltd., announces a reduction from 10 per cent to 7½ per cent in the interim dividend. In the earlier part of the year orders received were considerably lower than last year but there have since been signs of an improving trend.

Kango Electric Hammers, Ltd., has declared an interim dividend of 6 per cent on capital trebled by a "rights" issue. Last year an interim payment of 15 per cent was made on the smaller capital.

The Chloride Electrical Storage Co., Ltd., is maintaining its interim dividend at 5 per cent on increased capital, representing an effective increase of 1¼ per cent.

The Plessey Co., Ltd., has announced a one-for-two "rights" issue of 3,600,000 10s ordinary shares at a price of 23s 6d a share.

Aberdare (Holdings), Ltd., have declared an unchanged interim dividend of 7½ per cent.

New Companies

De La Rue Bu'l Mach'nes, Ltd.—Registered 23rd July. Capital £350,000. Manufacturers of and dealers in data processing machines, computers, tabulating machines, calculating and accounting machines, etc. Directors: A. G. Norman, A. L. Morrish, H. J. Phelps, J. P. D. M. Callies, G. M. P. Vieillard and M. M. P. Sanson. Regd. office: 84/6, Regent Street, W.1.

S. & J. Electrical Appliances, Ltd.—Registered 23rd July. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, radio and television receivers, etc. Directors: A. C. Sherwood and J. Jenkinson. Regd. office: 214, Bishopsgate, E.C.2.

Edwardes Bros. (Blackfriars), Ltd.—Registered 29th July. Capital £10,000. To acquire the business of electrical wholesalers carried on by T. D. Edwardes at 20, Blackfriars Road, S.E.1, as Edwardes Bros., etc. Directors: T. D. Edwardes and L. T. B. Edwardes. Regd. office: 20, Blackfriars Road, S.E.1.

D. Deakin (Electrical), Ltd.—Registered 10th July. Capital £100. Electrical engineers and contractors, etc. Directors: D. Deakin and Joyce O. Deakin. Regd. office: 62, Bankes Road, Small Heath, Birmingham.

Thomas & Rees (Electrical Contractors), Ltd.—Registered 29th April. Capital £5,000. Electrical engineers and general electrical installation contractors, etc. Directors: W. L. Thomas and Eileen Rees. Regd. office: 40, Brynamman Road, Brynamman, Ammanford, Carms.

Deac (Great Britain), Ltd.—Registered 7th May. Capital £10,000. Electrical equipment specialists, etc. Directors: C. W. Owen and W. Buchholz. Regd. office: 73a, The Trading Estate, Buckingham Avenue, Slough, Bucks.

Ellis, Di-Vita & Co., Ltd.—Registered 7th May. Capital £1,000. Manufacturers of and dealers in electrical apparatus, machines, accessories, and equipment, radio apparatus, etc. Solicitors: Ellis, Shieldhouse & Co., Epsom.

R. & J. (Electrical), Ltd.—Registered 7th May. Capital £100. Electrical engineers and contractors, electricians, electronics engineers, radio and television engineers, etc. Directors: R. Watt and J. Hyams. Regd. office: 123, Pall Mall, S.W.1.

By-Matic Washing Machine Co., Ltd.—Registered 5th May. Capital £1,000. Manufacturers of and dealers in domestic washing machines, spin dryers and accessories, etc. Directors: N. M. Fish and V. F. Jenks. Regd. office: 69, Wimpole Street, W.1.

Electric Meter Servicing Co., Ltd.—Registered 27th May. Capital £1,000. Manufacturers of and dealers in, servicers and repairers of electric meters, etc. Directors: N. G. Pulman and H. Hopkins. Regd. office: 36, Oakhill Road, Ashtead, Surrey.

Domestic Facilities, Ltd.—Registered 26th May. Capital £100. Manufacturers of and dealers in electrical equipment and goods of all kinds, etc. Directors: G. W. D. Yendell and A. E. Goode. Regd. office: 44, Lee Road, Chatham, Kent.

Cathode Ray Tubes, Ltd.—Registered 26th May. Capital £10,000. Electrical engineers and manufacturers and repairers of cathode ray tubes, etc. Directors: S. W. Carpenter, N. A. K. Carpenter and S. W. Carpenter. Regd. office: 758, Bristol Road, Selly Oak, Birmingham, 29.

Electrical & Electronic Supplies, Ltd.—Registered 25th May. Capital £1,000. Importers and manufacturers of and dealers in engineering and scientific instruments, etc. Solicitors: Kenneth Brown, Baker, Baker, Essex House, Essex Street, W.C.2.

Gaybank Electrical Industries, Ltd.—Registered 25th May. Capital £100. Electrical and general engineers, manufacturers of and dealers in engineers' equipment, ironfounders, etc. Directors: G. H. A. Haggis and Mrs. Jean Y. Haggis. Regd. office: 75, Tamworth Road, West Croydon.

D.D. Electrics, Ltd.—Registered 3rd June. Capital £100. Radio, television, electrical and electronic engineers, etc. Directors: F. W. Dilworth and Doris E. Dilworth. Regd. office: 264, Southend Road, Shotgate, Wickford, Essex.

Morheat, Ltd.—Registered 31st July. Capital £1,000. Manufacturers of and dealers in electrical plant, etc. Directors: R. R. C. Brock and Phyllis V. Loxton. Regd. office: 135, Brockhurst Road, Gosport, Hants.

British Lightning Preventor, Ltd.—Registered 3rd July. Capital £100. Inventors, designers and manufacturers of and dealers in

(*continued on page 201*)

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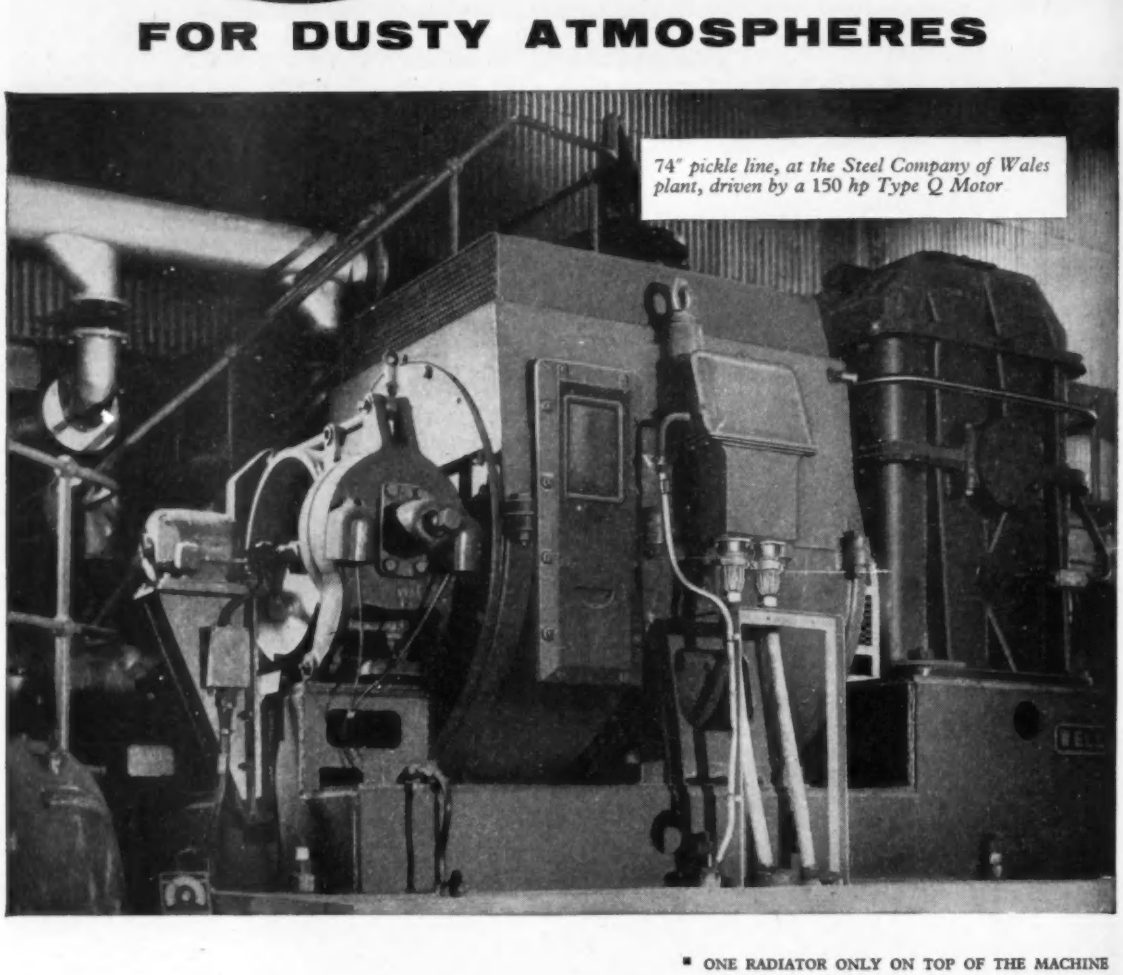

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INCORPORATING THE MOTOR & CONTROL GEAR INTERESTS OF BTH & M-V

JA706

New Companies (*continued*)

lightning preventors and conductors, etc. Directors: Lt.-Col. B. Starling (man. dir. Blackburn Starling & Co., Ltd.), Prof. W. D. Evans, Prof. J. C. Parton, Sir J. Lomax, K.B.E., J. F. Starling (Blackburn Starling & Co., Ltd.), and R. F. Prior. Regd. office: Midland Works, London Road, Nottingham.

Arthur Hughes & Son, Ltd.—Registered 25th May. Capital £5,000. To acquire the business of electrical and radio engineers carried on by A. Hughes at 5, Charles Street, Wrexham, etc. Directors: A. Hughes, Elizabeth J. Hughes and H. B. Hughes. Regd. office: 5, Charles Street, Wrexham.

V. J. Skerry, Ltd.—Registered 25th May. Capital £1,500. Manufacturers, repairers, installers and renters of and wholesale and retail dealers in electrical appliances and equipment. Directors: V. J. Skerry, P. G. Wilson and R. H. Rapley. Regd. office: 119, High Street, Huntingdon.

Niphan, Ltd.—Registered 2nd June. Capital £100. Electricians, mechanical engineers, suppliers of electricity, electrical engineers and contractors, manufacturers of and dealers in electrical, magnetic, electronic, galvanic and other apparatus, etc. Solicitors: Slaughter & May, 18, Austin Friars, E.C.2.

Banks Electrical Wholesalers, Ltd.—Registered 3rd June. Capital £10,000. Manufacturers, assemblers and designers of and wholesale dealers in electrical and electronic apparatus, and accessories, etc. Directors: A. P. Banks and Olive M. Banks. Regd. office: 4, Headland View, Hornsey, E. Yorks.

Electrician (Finchley), Ltd.—Registered 3rd June. Capital £12,500. Manufacturers, workers and retailers of all apparatus connected with the employment of electricity, etc. Directors: G. A. S. Pinkney and R. J. Pinkney. Regd. office: Bank Chambers, 1, John Street, Bedford Row, W.C.1.

T.S.C. Batteries, Ltd.—Registered 28th May. Capital £100. Manufacturers of and dealers in and repairers of electric accumulators, batteries, etc. Directors: J. Blacklock and Winifred Blacklock. Regd. office: Durranhill Industrial Estate, Carlisle.

Lakeland Electrical Services, Ltd.—Registered 28th May. Capital £2,000. Electrical engineers and general electrical installation contractors, radio and television engineers, etc. Directors: T. C. Pattinson and G. H. Pattinson.

D. O. & W. G. Hollands, Ltd.—Registered 3rd June. Capital £1,000. Manufacturers and repairers of and dealers in batteries, accumulators, magnetos, dynamos, etc. Directors: D. O. Hollands, Mrs. Joy E. Hollands, W. G. Hollands and A. Mears. Regd. office: 1, Arthur Street, Aldershot, Hants.

Glass (Electrical Contractors), Ltd.—Registered 3rd April. Capital £1,000. Electrical and mechanical engineers and contractors, etc. Directors: S. Glass, Ann Glass and E. C. Glass. Regd. office: 55, Cross Street, Manchester, 2.

Newfield Electrics, Ltd.—Registered 1st April. Capital £2,000. Electrical, mechanical, radio, television, telephone, lighting, heating, motor and general engineers, etc. Directors: D. A. Flavell, P. R. Allison and L. E. Wells. Regd. office: 13, Rockingham Street, Sheffield.

Winterwarm (Birmingham), Ltd.—Registered 23rd March. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, etc. E. L. Loveridge is the first director. Regd. office: 40, Welford Road, Birmingham, 20.

Pinnock Electrical Appliances (Great Britain), Ltd.—Registered 13th July. Capital £100. Solicitors: Slaughter & May, 18, Austin Friars, E.C.2.

L. & K. Electrical Installation, Ltd.—Registered 9th April. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: L. V. Zucker and K. H. Bizzell. Regd. office: 120, Regency Street, S.W.1.

Sontranic, Ltd.—Registered 10th April. Capital £1,000. Manufacturers of electrical apparatus, thermionic instruments, wireless transmitting and receiving equipment, television apparatus and component parts, etc. Directors: C. Croxson and R. G. Lane. Regd. office: 103, High Street, Edgware, Middx.

Benwell Electrical Supplies, Ltd.—Registered 20th April. Capital £500. Wholesalers, distributors and factors of and dealers in all kinds of electrical fittings, equipment, appliances and apparatus, radio and television receivers, etc. Directors: E. D. B. Cable and Audrey R. Cable. Regd. office: 133, Moorgate, E.C.2.

Kew Laminates, Ltd.—Registered 20th April. Capital £5,000. Manufacturers and fabricators of insulating materials for switchgear and for the electrical trade in general, etc. Directors: S. Ketch, C. R. Edmunds and S. L. Waters. Regd. office: 20, Mole Street, Sparkbrook, Birmingham, 12.

Erdington Electrical Co., Ltd.—Registered 22nd April. Capital £500. Electricians, electrical and mechanical engineers, etc. Directors: R. Powell and Mrs. Doreen V. Powell. Regd. office: 1206, Stratford Road, Hall Green, Birmingham, 28.

Shearman Electronic Industries, Ltd.—Registered 22nd April. Capital £1,000. Electrical engineering, including the manufacture, assembling, wiring, production and repair of electrical units, etc. Directors: F. R. Shearman and Edna V. P. Shearman. Regd. office: 111, Cecil Road, Enfield, Middx.

T. & C. Electronic Service, Ltd.—Registered 22nd April. Capital £100. Electrical, electronic engineers and contractors, radio and television engineers, etc. Directors: A. J. Barsham and Mrs. Rose A. Barsham. Regd. office: Odeon Buildings, London Road, Bognor Regis.

N. L. Electrical, Ltd.—Registered 30th July. Capital £1,000. Manufacturers of and dealers in artificial lighting apparatus, electrical plant, etc. Solicitors: Hine & Co., Barnet.

Temple Electrical Engineering Co. (B'ham), Ltd.—Registered 28th April. Capital £500. Electricians, electrical engineers, etc. Directors: J. F. Moroney and S. H. McCormick. Regd. office: 122, Colmore Row, Birmingham, 3.

Queens Park Electrical, Ltd.—Registered 16th July. Capital £1,000. To install, develop and operate radio and television relay equipment, electrical and electronic engineers, etc. Directors: J. E. Southall, Jean Southall, T. Skidmore and Gertrude Skidmore. Regd. office: 234, Court Oak Road, Harborne, Birmingham.

D. & R. Manufacturing (Peckham), Ltd.—Registered 28th July. Capital £100. Electricians, etc. Directors: K. W. Roberts and J. C. A. Drew. Regd. office: 1, Oglander Road, S.E.15.

Increases of Capital

Pye, Ltd.—Increased by £3,000,000 in 5s ordinary shares, beyond the registered capital of £6,000,000.

Lightfoot Refrigeration Co., Ltd.—Increased by £425,000 in 5s ordinary shares, beyond the registered capital of £325,000.

Jack Hinton (Electrical), Ltd.—Increased by £10,000 in 1,500 6 per cent redeemable cumulative preference and 8,500 ordinary shares of £1, beyond the registered capital of £5,000.

Hirst Electronic, Ltd. — Increased by £30,000 in 20,000 20 per cent preference and 10,000 ordinary shares of £1, beyond the registered capital of £10,000.

Liquidations

Central Electrics (London), Ltd., and **North Western Electrics (London), Ltd.**, dealers in electrical appliances, 207, Brondesbury Park, London, N.W.2.—Liquidator, Mr. B. Phillips, 76, New Cavendish Street, London, W.1, appointed by creditors 20th August. Particulars of claims to the liquidator by 25th September.

Everitts Electric (Cippenham), Ltd., radio and television dealers, 72, Bower Way, Cippenham, Slough, Bucks.—Liquidators, Mr. A. W. Hunter, Walter House, 418-422, Strand, London, W.C.2, appointed by creditors and Mr. R. C. Worrall, of Worrall, Vize & Co., 72, Bower Way, Cippenham, by the company on 31st July.

Industrial & Domestic Electrical Appliance Services, Ltd., dealers in domestic electrical goods, 13, Mansfield Street, London, W.1.—Liquidator, Mr. H. Evans, 2, Serjeants' Inn, London, E.C.4 (with committee of inspection) appointed 7th August.

Bankruptcy

T. Monaghan, 64, Welbeck Drive, Bradford, Yorks, electrician. — Receiving order made 17th August on a creditor's petition.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to the following dates:—

12th September

Amp. No. 766,048. Class 6. Castings, shaped sections and stampings, all of unwrought or partly wrought common metal, for use in the manufacture of electrical terminals and electrical connectors.—Amp Incorporated, Harrisburg, Penn., U.S.A. Address for service, c/o Urquhart-Dykes & Lord, Maxwell House, 11, Arundel Street, Strand, London, W.C.2.

Painton Flatpot. No. B783,963. Class 9. Potentiometers.—Painton & Co., Ltd., Membridge Drive, Kingsthorpe, Northampton.

Mectron. No. 789,236. Class 9. Electronic apparatus and instruments and parts.—Miniature Electronic Components, Ltd., 6, St. James's Place, London, S.W.1.

19th September

Laundwell. No. 786,380. Class 7. Domestic electric machines.—A.E.I.-Hotpoint, Ltd., 33, Grosvenor Place, London, S.W.1.

Preh (design). No. B784,390. Class 9. Switches, resistors, multiple rheostats, potentiometers, holders for thermionic valves; and plugs, sockets and connections.—W. Preh and A. Preh, trading as Preh Elektrofeinmechanische Werke Jacob Preh Nachfolger, Bad Neustadt/Saale, Germany. Address for service, c/o Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

Liberty Brand (design). No. 785,805. Class 9. Electric cables.—Industrial Suppliers Cambridge (1958), Ltd., 15A-17, Brecknock Road, London, N.7.

Coff-e-Matic. No. 787,446. Class 9. Electric coffee percolators and domestic electric coffee grinders.—Elliott Domestic Appliances, Ltd., Victoria Works, Victoria Road, Willesden, London, N.W.10.

Nanoscope. No. 788,441. Class 9. Electronic apparatus and instruments for use in measuring or indicating electric currents or voltages.—Lion Electronic Developments, Ltd., Lion Works, Hanworth Trading Estate, Feltham, Middx.

Hifi. No. 785,147. Class 11. Electric heating appliances, hair-drying appliances (not machines), fans, clothes drying cabinets, air conditioning apparatus, lighting fittings, etc.—Hifi, Ltd., Derry Works, Derry Street, Brierley Hill, Staffs.

NEW ELECTRICAL EQUIPMENT

Thermal Storage Water Heaters

Compared with the company's previous NC models the latest storage water heater to be introduced by A.E.I.-HOTPOINT, LTD., 33, Grosvenor Place, London, S.W.1, is shorter with better proportions, giving an improved appearance. The terminal cover is shallow and less obvious and a red double trim is included. Two sizes are available, 1·5 gal (model NE1A) and 2·2 gal (model NE2A). It is of

A.E.I.-Hotpoint latest styled water heater

flat-back design and seals flush with the wall with a rubber gasket. The water container is tinned copper, insulated with fibreglass, and the outer casing is stove enamelled. The heaters are fitted with a swivelled swan neck (12in radius). As an extra a 15in to 24in adjustable outlet spout can be fitted. Fitting has been simplified and is by means of three screws, without the use of a separate bracket. Water flow control is improved and the tap is of a new design. The prices remain the same as for the NC type, namely, £10 12s 6d (NE1A) and £11 (NE2A) plus £2 1s 6d and £2 2s 11d respectively for purchase tax.

Adjustable Cores

A range of adjustable ferrite pot core assemblies for electronic equipment coils is announced by MULLARD, LTD., Mullard House, Torrington Place, London, W.C.1. The inductance of coils wound on them can be pre-calculated to an accuracy of ±3 per cent, and a variable magnetic shunt is built into the core enabling the inductance of the assembled coil to be adjusted over a range of ±7 per cent with an accuracy better than 0·02 per cent. The cores are designed to give optimum electrical performance, including a low ratio of d.c. resistance to inductance, and the design ensures effective magnetic screening of the coil. The present range comprises five types for use at frequencies up to 200 kc/s, with outside core diameters of 18, 21, 25, 30 and 35 mm, and single or multi-section coil formers of polystyrene or low water-absorption nylon are available for each.

Instrument Scales

The standard short-scale switchboard instruments manufactured by CROMPTON PARKINSON, LTD., Crompton House, Aldwych, London, W.C.2, now incorporate dials in which unnecessary marking has been eliminated, data other than that required for actual reading and identification now appearing on the rear of the instrument casing.

Servo System Kit

Kits permitting the rapid experimental assembly of precision servo-systems are being manufactured by FEEDBACK, LTD., in association with SERVOMEX CONTROLS, LTD., Crowborough, Sussex, the various components being set up on a rigid base plate. The principal units of a standard kit consist of instrument quality gears, available in range 12 to 120 teeth, component mounts for most standard servo-motor fittings, bearings, flexible couplings, cams, etc.

Thermocouple Trip Amplifier

The fully-transistorised thermocouple trip amplifier announced by EKCO ELECTRONICS, LTD., Southend-on-Sea, Essex, has been primarily designed for use in nuclear reactor installations, but it also has many industrial applications. The type N642 monitors the temperature at a point within the plant and trips guard circuits by releasing a relay when the temperature reaches the pre-set trip level, set by a ten-turn helical potentiometer. A trip will also occur with an open-circuit thermocouple. The "low-margin" warning provided releases a second relay and can be set at any point within the meter range which can be supplied to cover up to 100 per cent of the ambient - to - trip - level range, with linear calibration.

Normally operated in conjunction with a chromel-alumel thermocouple, the type N642 can be used with other thermocouples with slight modification. It covers the range 0-250 deg C, though this can be extended up to 1,000 deg C if required. Four instruments can be installed side by side in a frame which fits a standard 19in rack.

Nickel Coating

The system of duplex nickel coating for improving the corrosion resistance of deposits developed by W. CANNING & CO., LTD., combines the advantages of their "Nivo" nickel with the levelling and brightness of B.Q.840 bright nickel solution, giving a corrosion protection equal to a polished Watts type nickel without the need for polishing. The initial deposit is obtained from high speed "Nivo" solution, from which components are transferred directly without rinsing into a B.Q.840 or B.Q.860 bright nickel solution to obtain a fully bright, levelled deposit.

Servo Test Equipment

The latest instrument in the range of test gear for use in servo and industrial control laboratories to be announced by SERVO CONSULTANTS, LTD., is a universal transfer function analyser. This self-contained equipment can be applied directly to the testing of most servo controlled systems and component parts. Advantages claimed for the instrument include its insensitivity to harmonic distortion introduced by the system under test, and the direct indication of phase angle and amplitude. A pamphlet giving full details of the instrument is available from the company at 17, Woodfield Road, London, W.9.

Spark Machining

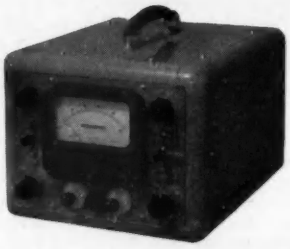
The "Sparcatron R.I.G." equipment produced by BURTON, GRIFFITHS & CO., LTD., Mackadown Lane, Kitts Green, Birmingham, 33, has a rate of stock removal up to 20 times faster than their standard Mark III machine.

Burton, Griffiths "R.I.G." equipment showing the machining head, control cabinet and the control panel for normal operation

The equipment consists basically of the normal Mark III machine head working in conjunction with a rotary impulse generator and a control cabinet, the latter being capable of accepting power supplies from 200 to 250 V, 340 to 440 V, and 500 V. A peak output of 280 A at a pulse frequency of 400 per second is provided by the 12·3 kVA generator, enabling the machine head to remove stock at approximately 4 cu in per hour, using brass, copper or other electrodes.

Insulation Tester

A self-contained, portable insulation tester with a maximum range of 20 million MΩ and internally generated non-lethal test voltages up to 10 kV has been announced by MILES HIVOLT, LTD., 91, Princedale Road, London, W.11. The test potential is separately



Miles Hivolt insulation tester

controlled, and the instrument may be switched to the stand-by position, the extra high voltage being applied only when required. The power supplies are obtained from easily replaceable standard batteries housed within the unit.

Alternators

Three additions have been made to the range of alternators manufactured by CROMPTON PARKINSON (CHELMSFORD), LTD., Crompton House, Aldwych, London, W.C.2. Self-regulating 50 c/s alternators in the PO series range from 70 kVA at 600 r.p.m. to 750 kVA at 1,500 r.p.m. and incorporate "Magnicon" exciters. The PXA series of 50 c/s machines have conventional exciters for use with automatic voltage regulating equipment and are manufactured in a range from 70 kVA at 600 r.p.m. to 1,500 kVA at 1,500 r.p.m. The AGT series is designed for coupling to gas turbine reduction gear boxes, the machines being of the single sleeve-bearing type. These revolving-field, salient-pole type machines range from 750 to 3,000 kVA at 1,500 r.p.m.

Lightweight Vacuum Cleaner

The "Carvac" vacuum cleaner for use in cars, caravans and yachts introduced by the TARPEN ENGINEERING CO., LTD., Ixworth House, Ixworth Place, London, S.W.3, operates from a 12 V battery. Two nozzles are included, for use on carpets and in

Tarpen vacuum cleaner

corners and crevices, and it is supplied complete with 15ft of cable and clips for connection to the battery terminals. Guaranteed for one year, it is priced at £7 15s 6d, plus £1 4s purchase tax, including accessories, cable and clips.

Counting Instruments

Two counting instruments have been announced by RADIATRON, 7, Sheen Park, Richmond, Surrey. Multi-circuit predetermined batch counters which have two or four pre-set count positions are available to record shaft rotation, electrical impulses or oscillatory movements. The counters change over two or four independent electrical contacts when the respective pre-set numbers are reached, the cycle being repeated by depressing a zero set lever or turning a detachable key. Electrical re-setting is available. Single counters having either electrical or mechanical release or for giving an audible warning signal only are also produced. The single and double counters can be supplied for up to six digits and the quadruple counters for up to three digits.

The electrical impulse counter also announced counts up to 20 a.c. or d.c. impulses per second having a minimum pulse length of 25 millisec for d.c. and 33 millisec for a.c. pulses.

Floor Cleaning Machines

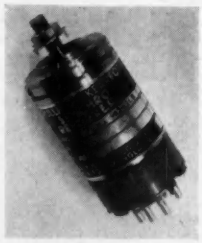
The "Electrostar" range of floor cleaning machines recently announced by TRUVOX, LTD., Neasden Lane, London, N.W.10, consists of three models—a three-brush polisher (E.1) and two three-brush combined polishers and vacuum cleaners (E.2 and E.3). All are fitted with three 6in polishing brushes and a set of three felt pads as standard, while special brushes for scouring and scarifying are available as extras. Wire wool discs and sanding discs are in course of preparation.

Model E.1 is fitted with a 400 W universal motor which gives a brush speed of 600/800 r.p.m. The weight is 22½ lb. The handle and dome of this machine are finished in lacquered nickel plate and the body is in bronze crystal enamel.

Models E.2 and E.3 are driven by 480 W and 650 W universal motors respectively and the weights, including the vacuum bag, are 26 lb and 46½ lb. The bodies of these machines are finished in blue crystal enamel with the dust bags in a matching shade. All three machines are fitted with 50ft of three-core cable and are guaranteed for twelve months.

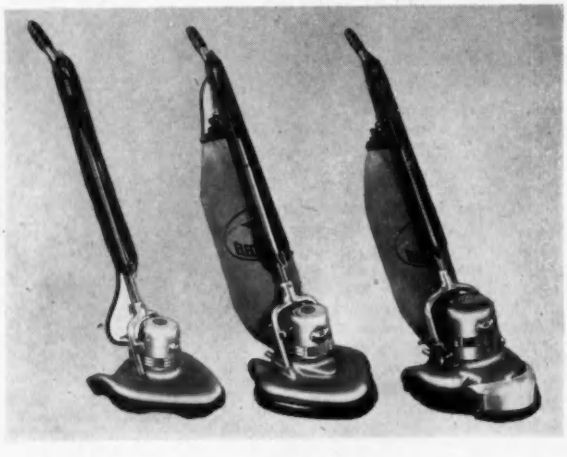
Synchro Resolvers

New synchro resolvers with two separate phases on the stator and two



Pullin synchro resolver

phases with one common terminal on the rotor are announced by R. B. PULLIN & CO., LTD., Phœnix Works, Great West Road, Brentford, Middx. The output is a sine and cosine expression of the angular position of the rotor and the resolvers are used in computer networks to rotate rectangular co-ordinates or for the conversion of cartesian co-ordinates to polar co-ordinates and vice versa. Two types



Truvox "Electrostar" range of floor cleaning machines.: Left to right, models E.1, E.2 and E.3

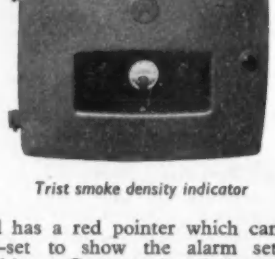
are available, for high and low impedance applications, the latter being suitable for high frequency operation on up to 10 kc/s systems. The resolvers are suitable for a 400 c/s input of 26 V and can operate in a temperature range from −50 to +100 deg C.

Electroluminescent Indicator

The electroluminescent indicator block now being manufactured by the Aircraft Components and Connector Division of THORN ELECTRICAL INDUSTRIES, LTD., 105-109, Judd Street, London, W.C.1, has a depth of only 0·265in and consists of 99 rectangular phosphor dots between two electrically conducting surfaces. By applying an alternating voltage of about 350 V at 400 c/s to these dots they are excited to luminescence.

Smoke Density Indicator

In the smoke density indication equipment manufactured by RONALD TRIST & CO., LTD., Bath Road, Slough, Bucks., a beam of light is passed across the stack or flue and falls on a cæsium-silver photocell coupled electrically to an indicator in the control unit. The optical units are of weatherproof cast aluminium construction, suitable for rigid conduit external wiring. The 6in scale remote indicator is calibrated 0-100 per cent obscuration



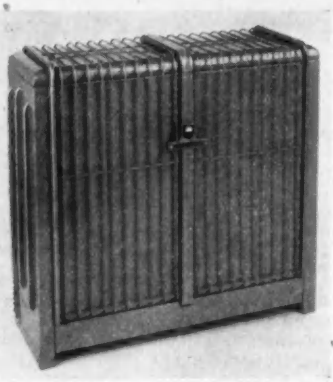
Trist smoke density indicator

and has a red pointer which can be pre-set to show the alarm setting position. Green and red "normal" and "alarm" lamps are visible, with a 2½in scale calibrating meter, through the front face of the dustproof control unit door. Auxiliary contacts for alarm circuits are included.

Thermodare Heating Developments

A new system of ducting for under-floor heating which is claimed to ensure a perfect floor finish is announced by THERMODARE (GREAT BRITAIN), 94-98, Petty France, London, S.W.1. By the use of precision extruded aluminium, produced by the company's new aluminium processing plant, the difficulties encountered in previously accepted methods of under-floor heating are said to have been overcome. The new system also makes ducting available for other services.

Among its advantages are lightness in weight; ease of cutting; non-rusting; and the fact that earth continuity is ensured by the positive bonding



Thermodare 3 kW night storage heater

designed into the system. The price compares favourably with other systems and a brochure (DS.9) describing the system in detail may be had upon application to Thermodare.

The company has also added a 3 kW model to its existing range of night storage heaters. The heater has the exclusive Thermodare thermal link and built-in guard, and also easy-access side entry terminal box. It measures 31in high by 12in wide by 32in deep and the weight is 580 lb. The floor space taken up is exactly equal to that of the company's horizontal models and the height is identical to that of the vertical models. Surface temperatures are within the requirements of the E.D.A. recommendations. The heater, to be known as Model L.30, is priced at £22 10s.

Agricultural infra-red units are another Thermodare development. Designed primarily for the broiler industry, the heaters embody the advantages of both the bright and dull emitter in that they produce heat at the 3-micron waveband, where heat is transmitted most favourably to animal life. The visible light is cherry red in colour, which conforms to the colour rendering required within the broiler house to prevent "cannibalisation." The overall length is 33in, the finish is green and they are designed to radiate downwards. The range comprises 250, 800, 1,200 and 2,000 W models and an average loading of 2 W per chick is recommended. The prices range from £5 4s 6d (250 W) to £7 19s 6d (2 kW).

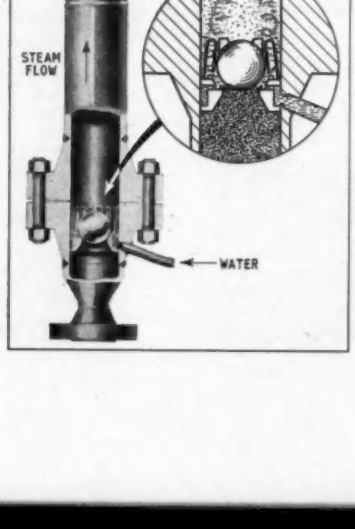
Glass Tube Cutter

A double-wound transformer having an earthed screen between the primary and secondary windings provides a low voltage supply for heating a nickel/chrome wire in the glass tube cutter developed by ELECTROTHERMAL ENGINEERING, LTD., 270, Neville Road, London, E.7. Hard and soft glass tubes up to 3in diameter are cut by rotating the tube against a cutting wheel and holding the resulting scratch mark against the hot wire. Models are available for use on 200/250 V or 100/120 V supplies, priced at £14 10s, complete with 20ft of 27 s.w.g. nickel/chrome wire and a set of six cutting wheels.

Variable-Orifice Desuperheater

A NEW approach to desuperheating was shown at this year's Engineering, Marine, Welding and Nuclear Energy Exhibition by Copes Regulators, Ltd. The variable-orifice desuperheater was first developed by the Copes-Vulcan division of the Blaw-Knox Co., U.S.A., and it makes attemperating with water spray unnecessary.

Desuperheater showing principle of operation



Reference to the accompanying diagram shows the principle of operation of this type of desuperheater. Incoming steam lifts the steel ball by an amount determined by the weight of the ball and the amount of the steam flow. Each rate of flow gives the ball a different position with a constant pressure drop, normally 3-4 p.s.i., for all flows. Cooling water enters the steam at the seat of the orifice, the point of highest pressure drop. The incoming steam flows uniformly around the periphery of the ball and the resultant high turbulence immediately behind the ball intimately mixes water with steam for quick, complete vaporisation.

Cooling water flow is controlled by a diaphragm-operated Copes-Vulcan valve responsive to the temperature control. Cooling water pressure should be at least 30 p.s.i. above steam pressure and the desuperheater will hold a final steam temperature within ±5 deg F. This desuperheater is suitable for main steam pressures between 150 and 2,500 p.s.i. with control from 2 to 100 per cent of load.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1954

16509. Telegraph Construction & Maintenance Co., Ltd.—Trapped rubber joints between electric cables and surrounding enclosures. 2nd September, 1955. (816472.)

29080. General Electric Co., Ltd., and Easter, B.—Electrical monitoring devices. 10th October, 1955. (816650.)

32848. British Thomson-Houston Co., Ltd.—Sealing-off of envelopes such as those of electric lamps. 25th October, 1955. (816501.)

1955

3420. British Thomson-Houston Co., Ltd. —Monofuel reaction chamber apparatus. 6th February, 1956. (816752.)

3715. British Oxygen Co., Ltd.—Methods for depositing alloy coatings by gas shielded electric arcs. 3rd February, 1956. (816391.)

15966. English Electric Co., Ltd.—Electrical induction relays. 4th June, 1956. (816401.)

18288. Ether, Ltd.—Electrical controllers. 4th June, 1956. (817053.)

19861. Unger, H.—Electric heater for liquids. 8th July, 1955. (816905.)

24447. Ebonite Container Co. (Manufacturing), Ltd.—Battery separators. 26th November, 1956. (816676.)

24477. General Electric Co.—Semiconductor rectifying circuit arrangements. 25th August, 1955. (816476.)

26033. Veb Werk für Signal- und Sicherungstechnik.—Polarised relay. 12th September, 1955. (816631.)

26725. Ziegler, K., and Ruthardt, K.— Insulating coating of oxidised electrodeposited aluminium on copper conductors. 19th September, 1955. (816574.)

27136. Electric & Musical Industries, Ltd. —Moving coil electro-mechanical transducers. 10th September, 1956. (816678.)

27505. Mallory Batteries, Ltd.—Electrodes for electric batteries. 27th September, 1955. (816605.)

28519. General Electric Co.—Semiconductor devices utilising germanium. 6th October, 1955. (816466.)

30889. Tesla, Narodni Podnik.—Relay chain for receiving and counting out trains of electric impulses. 28th October, 1955. (816711.)

31589. Garnerot & Co. (Consolidated Agencies), Ltd.—Means for detachably securing leads to electrical connectors. 4th November, 1955. (816373.)

32181. Igranic Electric Co., Ltd.—Excitation circuits for dynamo-electric machines. 10th November, 1955. (816733.)

32409. Cole, Ltd., E. K., and Green, H. H. H.—Electromagnetic cavity resonators. 12th November, 1956. (816469.)

32995. General Electric Co.—Temperature sensitive elements and method of making same. 17th November, 1955. (816712.)

36125. General Electric Co.—Process for treating silicon steel. 16th December, 1955. (816705.)

36614. International Business Machines Corporation.—Device for comparing digital data represented by electric signals. 21st December, 1955. (816436.)

36775. International Business Machines Corporation.—Contact making device for use in electrical circuits. 22nd December, 1955. (816397.)

1956

13004. Philips Electrical Industries, Ltd. —Transistor modulators. 27th April, 1956. (816660.)

13659. Belling & Lee, Ltd.—Electrical fuses. 18th April, 1957. (816706.)

16731. Svenska Aktiebolaget Gasaccumulator.—Electrical stand-by unit arrangement for signal radiating devices. 30th May, 1956. (816451.)

16858. Marconi's Wireless Telegraph Co., Ltd.—Frequency changing circuit arrangements. 7th March, 1957. (816661.)

17245. Parnall (Yate), Ltd.—Clothes dryers. 22nd May, 1957. (816565.)

19765. General Electric Co., Ltd., and Judson, A. E.—Bell assemblies. 25th June, 1957. (816662.)

20133. Roberts & Armstrong (Engineers), Ltd., and Armstrong, J.—Travelling wave electronic valve amplifier. 28th June, 1957. (816663.)

21088. Postmaster General.—Electric cables. 5th July, 1957. (Cognate application 24881, 14th August, 1956). (816633.)

22411. Philips Electrical Industries, Ltd. —Alternating voltage stabilisers. 19th July, 1956. (816737.)

22874. Blackwell & Co., Ltd., F. C., and Griffin, A.—Electrical switch, socket or like wall boxes. 18th October, 1957. (816738.)

24612. Tate, A. E.—Connectors for electric power cables. 7th August, 1957. (816635.)

27820. Canadian Minister of National Defence.—Doppler radar system. 11th September, 1956. (816716.)

27943. Bendix Aviation Corporation.— Amplitude selective translation circuit. 12th September, 1956. (817058.)

27975. Standard Telephones & Cables, Ltd.—Electro-forming processes for semiconductor devices. 13th September, 1956. (816717.)

29166. Grimson Color, Inc.—Television systems. 24th September, 1956. (816379.)

29294. General Electric Co., Ltd., Harling, D. W., and Hine, R. G. B.—Apparatus for demodulating amplitude modulated electric signals of a kind including a vestigial sideband. 23rd December, 1957. (817059.)

29732. Fuller, L., and Sudlow, E. W.— Electrical storage batteries. 5th December, 1957. (817079.)

30894. Radio Heaters, Ltd.—High frequency heating equipment. 13th November, 1957. (816621.)

32680. Electric Machinery Mfg. Co.— Electrostrictive ceramic materials. 26th October, 1956. (816707.)

34315. Philips Electrical Industries, Ltd. —Amplifying circuits. 9th November, 1956. (816664.)

34374. General Electric Co., Ltd.—Electric contact arrangements. 11th November, 1957. (816636.)

35099. Westinghouse Electric International Co.—Electron beam tubes. 16th November, 1956. (816452.)

35317. Texas Instruments, Inc.—Field-effect transistor and method for making same. 19th November, 1956. (816740.)

1957

1806. Pour l'Industrie l'Aluminium S.A.— Electrolytic cells for the production of aluminium. 17th January, 1957. (816587.)

4087. Philips Electrical Industries, Ltd.— Securing electrical contact-carrying members to glass vessels. 6th February, 1957. (816757.)

4094. Bofors A.B.—Apparatus for determining the time integral of an electrical time-varying quantity. 6th February, 1957. (816454.)

4882. Revo Electric Co., Ltd.—Tubular fluorescent lighting fitting. 5th February, 1958. (816742.)

5100. Compagnie Française Thomson-Houston.—Anode cooling for electronic tubes. 14th February, 1957. (816693.)

7205. Mochi, E. G.—Method of and means for sealed housing of electrical apparatus. 5th March, 1957. (816639.)

9763. Pearce Signs, Ltd., and Pearce, J. H. G.—Artificially illuminated signs and display panels. 28th March, 1958. (816710.)

10200. Erie Resistor, Ltd.—Electrical connection means for panel-mounted electrical components. 25th July, 1957. (816694.)

12249. Westinghouse Electric International Co.—Electric motor control apparatus. 15th April, 1957. (816456.)

13232. Compagnie Générale de Télégraphie sans Fil.—Travelling wave tubes. 25th April, 1957. (816411.)

13404. Siemens-Reiniger-Werke A.G.— Apparatus for electrical high-frequency surgery. 26th April, 1957. (816720.)

15092. Erie Resistor Corporation.— Printed circuit. 13th May, 1957. (Addition to 725115.) (816458.)

21376. Standard Telephones & Cables, Ltd.—Electric wave filters. 5th July, 1957. (816463.)

23417. Westinghouse Electric International Co.—Steam generators. 24th July, 1957. (816744.)

25910. Westinghouse Electric International Co.—High voltage coils for dynamo electric apparatus. 16th August, 1957. (816699.)

26287. Jackson Industries, Ltd. (Fischer, K.).—Snap-action electric switches. 20th August, 1957. (816642.)

26837. Mullard, Ltd.—Automatic gain control circuit arrangements for television receivers. 26th August, 1957. (816725.)

28164. Standard Telephones & Cables, Ltd.—Support for the rotatable part of measuring, recording, indicating or switching apparatus, and particularly for a relay armature. 6th September, 1957. (816644.)

29708. Siemens & Halske A.G.—Telecommunications circuit arrangements for subscribers' stations having keyboard selection. 20th September, 1957. (816700.)

29938. Burndy Corporation.—Compressible insulated connector for a shielded cable. 24th September, 1957. (816499.)

31122. Erie Resistor Corporation.—Pulse transformer. 4th October, 1957. (816414.)

31160. Standard Telephones & Cables, Ltd.—Band-pass filters. 4th October, 1957. (816727.)

31487. Accumulatoren-Fabrik A.G.— Alkaline electrical accumulators. 8th October, 1957. (816629.)

32802. Telefonaktiebolaget L. M. Ericsson.—Signal devices. 21st October, 1957. (816667.)

33383. Standard Telephones & Cables, Ltd.—Check number generating equipment. 25th October, 1957. (816500.)

34222. Sylvania Electric Products, Inc.— Wire-coiling machine. 1st November, 1957. (816595.)

34640. Sulzer Freres S.A.—Steam power plants. 6th November, 1957. (816765.)

34702. General Motors Corporation.— Manufacture of commutators for dynamo-electric machines. 7th November, 1957. (816387.)

39817. Singer Manufacturing Co.— Rotatably mounted domestic electric appliances. 23rd December, 1957. (816416.)

1958

2457. Standard Telephones & Cables, Ltd. —Automatic gain control circuit. 24th January, 1958. (816902.)

1959

227. Healy, D. V.—Electro-hydraulic valves. 2nd August, 1955. (Divided out of 816773.) (816775.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—Electricity Supply Commission of New South Wales, Sydney. 28th September. Specification No. 954 has been extended to include 330 kV circuit-breakers and associated equipment for Vales Point power station. (E.S.B. 18629/59. Ten/41011A.)*

Postmaster General's Department, Melbourne. 15th October. Three- and four-channel open wire carrier equipment. (E.S.B. 19192/59. Ten/41214.)*

Department of Civil Aviation, Melbourne. 27th October. Airport surveillance radar system. (E.S.B. 19128/59. Ten/41215.)*

Bristol.—Corporation. Supply of lamps and electrical equipment. (See this issue.)

Canada.—Saskatchewan Power Corporation. 30th October. Water wheel driven generators. (E.S.B. 19766/59. Ten/41328.)*

Ceylon.—Colombo Port Commission. 7th October. Traction batteries. (E.S.B. 19796/59. Ten/41332.)*

Ministry of Transport and Power. 23rd September. House wiring cables. (E.S.B. 20072/59. Ten/41400.)*

Formosa.—Central Trust of China, Taipei. 11th September. Generators, pumps and air conditioning equipment. (E.S.B. 19834/59/I.C.A. Ten/41382.)* Hydraulic compressors, aluminium cable and rods, joint sleeves, dead ends, etc. (E.S.B. 19364/59/I.C.A. Ten/41287.)* 14th September. Line and jumper spacers. (E.S.B. 19836/59/I.C.A. Ten/41392.)* 17th September. Miners' cap lamps and lamp charging equipment. (E.S.B. 19833/59/I.C.A. Ten/41389.)*

Havant and Waterloo.—U.D.C. 17th September. Street lighting equipment. (See this issue.)

India.—Bihar State Electricity Board, Patna. 14th September. A.c.s.r. conductors and accessories. (E.S.B. 19904/59. Ten/41360.)* 21st September. 3·3, 11 and 33 kV air-break switches. (E.S.B. 19905/59. Ten/41361.)*

National Coal Development Corporation (P.), Ltd. 29th September. Three-core cable. (E.S.B. 19140/59. Ten/41137.)*

Bombay State Electricity Board. 11 and 66 kV switchgear. Closing date for receipt of tenders postponed to 18th September. (E.S.B. 18178/59. Ten/40840A.)*

India Store Department, London. Wet dock cables for Madras Port Trust. (See this issue.)

Hindustan Chemicals & Fertilisers, Ltd., Naya Nangal. 31st December. Ammonia, urea, nitric acid and nitro-phosphate plants. (See this issue.)

Assam State Electricity Board. 15th September. Nine 1,000 kW and nine 300/500 kW diesel generators. (E.S.B. 2038/59. Ten/41487.)*

Korea.—Office of Supply, Seoul. 16th September. Two motor-generator sets and mining machinery. (E.S.B. 19561/59/I.C.A. Ten/41340.)*

Leeds.—Regional Hospital Board. 6th October. (a) 11 kV, 500 kVA transformers, switchgear and cables and (b) m.v. switchgear and distribution cables for St. James's Hospital. (See this issue.)

New Zealand.—State Electricity Department, Wellington. 3rd November. Seven single-phase 127/63·5/11 kV auto-transformer units to form two 110 MVA three-phase outdoor banks with a spare unit. (E.S.B. 19529/59. Ten/41269.)*

Norway. — Norwegian Joint Signals Administration, Oslo. Coaxial cables with connectors for a radio receiving station. (G.D. 5765/58. Ten/41492.)*

Pakistan.—Director General of Supply and Development, Chittagong. 21st September. H.v. cable. (E.S.B. 20301/59. Ten/41464.)*

United States.—Bureau of Reclamation, Denver, Colorado. 22nd September. 20 MVA, 230 kV three-phase auto-transformer with 5·5 MVA tertiary winding. (E.S.B. 19973/59. Ten/41363.)*

Worksop.—Corporation. 14th September. Street lighting installation. (See this issue.)

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Chester.—Corporation. Recommended. Electrical installation work at Woodfield Infants' School (£1,738).—Thomas Wood & Sons.

Ealing.—Works and Highways Committee. Recommended. Lanterns required in connection with scheme for conversion from gas to electric street lighting (£8,242).—A. C. Ford.

Guildford.—Works Committee. Recommended. Class "A" lighting in Farnham Road and Epsom Road (£12,813.)—B. French.

Hull.—Corporation Telephones Committee. Telephone instruments (£13,025).—Siemens Edison Swan.

Middlesex.—County Education Committee. Renewal of electrical installation at Elmers Court Residential Special School, Lymington, Hants (£1,050).—F. W. Cook & Co. (Southampton).

Stockport.—Corporation. Recommended. Electrical installation work at Gale Green Primary School (£1,137).—Hobson & Scott.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Abbots Bromley (Staffs.).—Houses (41), School Lane site; surveyor, Council Offices, Holly Dene, High Street, Uttoxeter, Staffs.

Aberdeen.—Extensions and alterations, Bridge of Don School; county architect, 25, Union Terrace, Aberdeen.

Aldershot.—Houses (84), Heron Wood estate; Boucher & Dobson, Ltd., High Street.

Bacup.—Fire station, Fairview Road/Rochdale Road site (£43,400); borough surveyor, Municipal Offices, Stubbylee Hall.

Billingham-on-Tees.—Houses (131), Roseberry Road estate; E. Shaw, U.D.C. surveyor.

Bingley.—Extensions to training college (£210,000); West Riding county architect, Bishopgarth, Westfield Road, Wakefield.

Brecon.—Office block; W. & A. Davies, Ltd., Abersychan, Pontypool.

Brighton.—Primary school, Westdene; planning officer, 26/30, King's Road.

Bromsgrove.—Stage two of County High School; Yorke, Rosenberg & Mardall, architects, 2, Hyde Park Place, W.2.

Bullingdon.—Houses (60); J. Busfield, R.D.C. surveyor, 76, Banbury Road, Oxford.

Cheltenham.—Extensions to Monkscroft School (£47,119), for County E.C.; county architect, Shire Hall, Gloucester.

Chipping Norton.—Factory; John Bruce (Engineers), Ltd., Eynsham, Oxford.

Feltham.—Office block for Simmons & Hawker, Ltd., Faggs Road; John Laing & Son, Ltd., Page Street, London, N.W.7.

Gloucester.—Modernisation of 152 pre-war houses; W. J. Knight, clerk, Berkeley Chambers, Gloucester.

Hastings.—Grammar school (£184,400); borough engineer, 37, Wellington Square.

Haywards Heath.—Houses (300), Harlands Farm estate; G. Breeze & Co., Ltd., Grange Mews, Grange Road, Eastbourne.

Hemel Hempstead.—New hostel for nurses, out-patients' department and surgical block, West Herts. Hospital; regional architect to Hospital Board, 40, Eastbourne Terrace, London, W.2.

Hinckley.—Council offices on site adjoining Argents Mead (£250,000); U.D.C. surveyor, Station Road.

Kent.—Additional buildings at Maidstone Grammar School, Chatham House Grammar School for Boys, Ramsgate, and Swanley Secondary School, and new secondary school, Ramsgate; E. T. Ashley Smith, county architect, Springfield, Maidstone.

Leamington Spa.—Factory extension for Lockheed Hydraulic Brake Co., Ltd.; Turriff Construction Corporation, Ltd., Budbrooke Road, Warwick.

Liverpool.—Operating theatre block, Royal Infirmary; Regional Hospital Board, 88, Church Street.

Showrooms and offices, London Road and Lambert Street; Arndale Property Trust, Ltd., 120, Swan Arcade, Bradford.

Llwchwr.—Four blocks of flats, Corporation Road, Loughor; clerk to U.D.C., Council Offices, Gorseinon.

London.—Eleven-storey block of flats, Camilla Road, Bermondsey; Fredk. S. Snow & Partners, consulting engineers, Monro Building, Wellington Street, W.C.2.

Multi-storey office block, Charing Cross Road and William IV Street; Petra Investments, Ltd., 97, Mortimer Street, W.1.

Dwellings (212), White Hart Lane, Tottenham; borough engineer.

Showrooms, offices and flats, Stag Brewery site, Westminster; City of London Real Property Co., Ltd., 16, Mark Lane, E.C.3.

Shops and flats, 35/47, Kings Road, Chelsea; E. A. Stone, Toms & Partners, architects, 28, South Audley Street, W.1.

Showrooms and offices, Windmill Street, Piccadilly; Austin Vernon & Partners, architects, 5, Buckingham Place, S.W.1.

Multi-storey parking garage, Audley Street and Waverton Street, Westminster; Frank Risdon, architect, 47, Bedford Row, W.C.1.

Loughborough.—New science block at College of Technology for Leics. C.C.; county architect, Leicester.

Luton.—Office block, Upper George Street and Stuart Street; J. M. Hill & Sons, Ltd., Church Street, Ampthill.

Merthyr Tydfil.—Omnibus garage; G. Warlow & Co., Ltd., Warlow Street.

Middlesbrough.—Office block, Albert Road, for Bradford Equitable Building Society, Ltd., Bradford.

Shop and office block, Corporation Road and Dundas Street, for Pearl Assurance Co., London.

St. Pauls Cray.—Factory; Algraphy, Ltd., Willowbrooke Grove, London, S.E.15.

Stafford.—Twin operating theatre suite, General Infirmary; F. & E. V. Linford, Ltd., Wolverhampton Road.

Tamworth.—Council offices; E. W. Haysom, architect to R.D.C., Curtis House, Poplar Road, Solihull, Warwicks.

Whitley Bay.—Houses (72), Cragside, and blocks of flats on Monkseaton estate; Waring & Netts, architects, 36, Jesmond Road, Newcastle-on-Tyne.